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HEARING BEFORE AND AFTER RADICAL MASTOIDECTOMY

PLEA FOR AVOIDANCE OF THIS OPERATION BY EARLY ADEQUATE DRAINAGE; SUMMARY OF FIFTY-FOUR CASES WITH AUDIOGRAMS AND CLINICAL AND ROENTGEN FINDINGS

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Although a radical mastoidectomy is undertaken primarily to protect the patient (and the ear) from the more serious consequences of chronic suppuration, it is important to know not only what is likely to happen to the hearing if the operation is done but what is likely to happen if it is not done. It is important to know this not only for the worse ear but for the better ear. The surgeon seems loath to test the better ear or even the worse ear before or after mastoidectomy.

By a radical mastoidectomy I mean the necessary cleaning out of the mastoid cells plus the lowering of the posterior canal wall, the removal of the malleus, incus and diseased membranes and bone in or about the middle ear, aditus, antrum and eustachian tube, and the cutting of a meatal flap. This procedure cleans out the middle ear, with the exception of the stapes, and converts the whole bony operative field into one wide-open cavity. The type of flap is of less importance than the skill of the surgeon in fitting it to the cavity.

The indications for the radical operation may be briefly stated to be:

1. Suppuration of long (often many years') standing, which fails to improve after months of careful and continuous management and treatment.

2. Persistent polypoid growths in the external auditory canal or in the spaces of the middle ear.

3. Symptoms or signs of impending complications, i. e., increasing loss of hearing, vertigo, fistula into the semicircular canals, elevated temperature, pain and exacerbations, especially with sudden cessation of the discharge, paralysis of the external rectus or the facial muscles, and progressive osteitis or osteomyelitis of the petrous pyramid and cholesteatoma, often confirmed by stereoroentgenograms.

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4. Continuous and foul odor from a discharge in the ear or into the throat from the eustachian tube.

Any or all of these symptoms may be present, and yet without any operation the suppuration may cease. It is often as impossible to lay down positive indications for radical mastoidectomy as for radical petrosectomy, and this is one excuse for delaying the operation.

A standing order in my clinic is that no radical mastoidectomy shall be done without a prior audiometric test. This rule is adhered to, but unfortunately patients often fail to report when their ears have become dry, the surgeon often neglects to put down the date of the cessation of discharge or the postoperative hearing test is not made.

I have collected from my own clinic fifty-four cases in which hearing tests were carefully made before and after operation. In my personal cases several tests were made to eliminate the practice factor. In all instances audiograms showing the loss of hearing shortly before operation and the latest hearing level were chosen for comparison. To illustrate these audiograms and the histories in detail would consume too much time and space and would be rather confusing. It will be better to analyze and summarize the findings.

In order to obtain a simple and definite figure for the acuity of hearing the audiogram curves were averaged for the frequencies most useful for hearing speech (256 to 4096). A change of 5 db. (decibels) was not considered a convincing change in the hearing level because such small variations may be caused by a drop of secretion in the cavity of the middle ear or by transient variations in hearing from other factors. Even though the ear is carefully cleansed (before operation), it will contain some secretion before it is tested. In some instances it probably was not carefully cleansed and in consequence the hearing was registered at an unnecessarily low level. In all but a few instances the ear was dry (healed) when the postoperative test was made. All ears not actually recorded as dry were considered still discharging.

I call attention first to chart 1. It presents a composite picture of the audiograms of the fifty-four better ears and of the fifty-four worse ears before and after radical mastoidectomy on the latter. The downward shift is plainly visible. The curves below show the average hearing before and after the operation.

It is clear that on the average the operation has not benefited the hearing in either ear. It has, on the contrary, been followed by an average loss of hearing of about 5 db. in the ear operated on and an average loss of 5 db. in the hearing of the better ears. In two cases the latter were subjected to the radical operation, although in both instances the opposite ears were the deafer because of chronic suppuration and radical operations. An average loss of 5 db. for fifty-four ears means a definite average loss, because normal variations and factors which may change the hearing in a single ear to this extent are absorbed

or smoothed out in the average curves. In a few cases there was a leveling of the curves, but without any change in the average.

The distribution according to sexes was twenty-two females and thirty-two males; according to ears, right thirty-two and left twenty-two. (In all my statistics concerning disease of the mastoid the right ear predominates.)

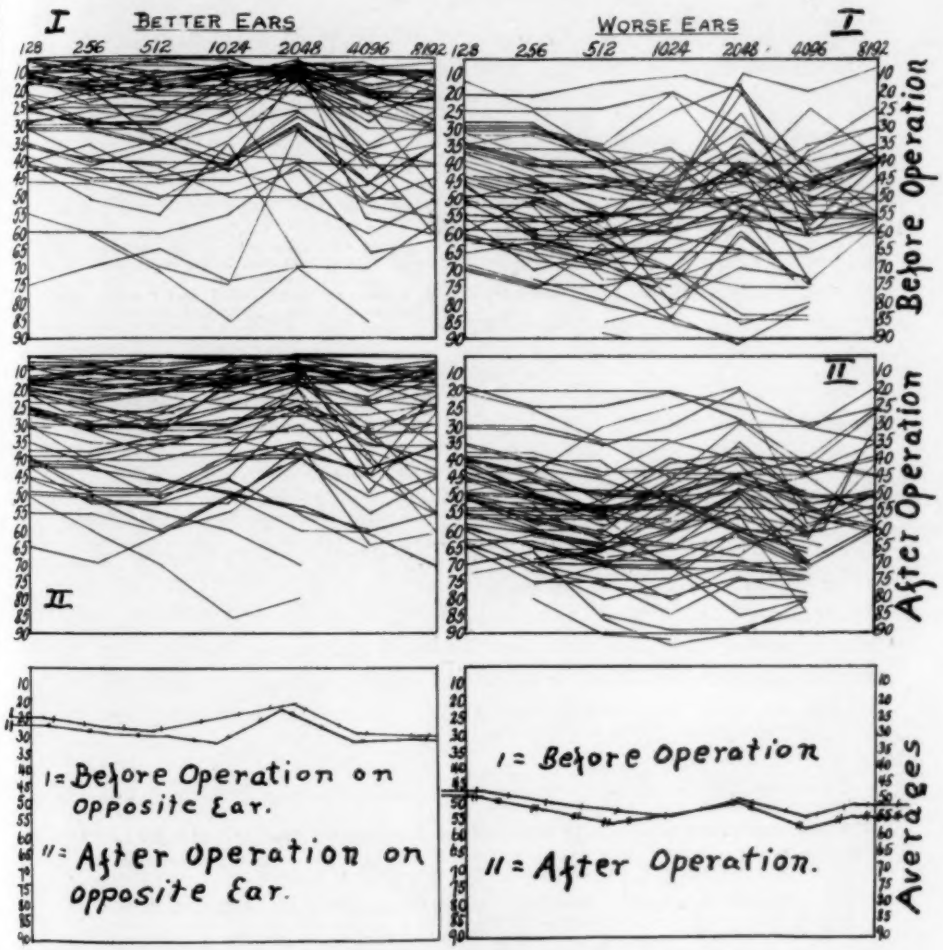

Chart 1.—A composite picture of the audiograms for the fifty-four better ears and for the fifty-four worse ears before and after radical mastoidectomy on the latter.

A detailed study of the changes in hearing in the ear operated on (with two exceptions the better ear) is summarized in the table.[1]

1. Miss Marie Pless, of the New York League for the Hard of Hearing, assisted with the testing and with the collection and tabulation of data.

In almost every instance the better ear showed evidences of inflammatory episodes in the past, and in 75 per cent of the cases there was a definite history of prior suppuration in that ear. One ear had undergone a prior simple mastoidectomy and two a prior radical mastoid-

Changes in Hearing of the Worse and the Better Ears Following Radical Mastoidectomy on the Worse Ear

Male	Female			
		Improved Hearing (Over 5 db.)		
3	2	In both ears	5	
6	5	In worse ear	11	(Hearing in 3 better ears decreased and in 4 improved 5 db., 4 remained stationary)
2	1	In better ear	3	(All 3 worse ears improved 5 db.)
			19	
		Decreased Hearing (Over 5 db.)		
3	2	In both ears	5	
8	5	In worse ear	13	(2 better ears improved 10 db. or more, 4 better ears decreased 5 db. or more, 7 remained stationary)
3	1	In better ear	4	(2 worse ears improved 5 db., 1 worse ear decreased 5 db., 1 remained stationary)
			22	
		No Change in Hearing		
7	6	In both ears	13	(No change over 5 db., up or down)
32	22		54	

Stated in Another Way, the Data Show:

	Hearing Improved	Hearing Decreased	No Change	Total
Worse (ears operated on)	16	18	20	54
Better (ears not operated on)	10	9	35	54
Better and worse ears (22 reversed the change in the opposite ear)	5	5	22	

	Number of Cases	Percentage
Hearing remained stationary in both ears (1 in 4)	13	25
Hearing improved in both ears (1 in 11)	5	9
Hearing decreased in both ears (1 in 11)	5	9
Acted the same as to hearing in both ears	23	43
Acted differently as to hearing in both ears	31	57
	54	100

With 1 exception, the worse ears in which hearing improved the most (15 to 25 db.) were in children

With 4 exceptions, the worse ears in which hearing decreased the most were in older adults

Both the better ears and the worse ears in which hearing went down the most were in the older patients with 3 exceptions, 1 better ear and 2 worse ears

In 1 better ear the hearing went down 30 db. and in the opposite worse ear only 12 db.
In 2 better ears the hearing went down 20 db.
In 7 worse ears the hearing went down over 20 db.
There were 35 better ears and 20 worse ears which showed no change

ectomy. For all of the worse ears there was a history of suppuration of many years' standing (six had undergone prior simple mastoidectomies).

The operation cannot be given credit for the improvement in the ten better ears not operated on, because among ears with similar lesions an equal percentage will improve without any operation on the opposite

ear. The skin grafts were of little service (in six instances no change resulted, four ears decreased in hearing and four improved in hearing).

It is apparent from the data that with few exceptions little or no improvement in hearing followed the radical operation, which in every instance was undertaken because of the usually accepted indications. The so-called modified radical mastoidectomy is misnamed. It is in fact a modified simple mastoidectomy, and I shall not discuss it at this time further than to state that in instances of long-continued suppuration it has not been of much value for increasing the hearing. The damage to the conducting mechanism is then permanent.

Attention is called to the fact that none of the ears operated on had undergone a simple mastoidectomy at an early stage of the suppuration and only six at any stage of the disease. One simple operation had been done on a better (healed) ear. Herein lies the crux of the problem of the prevention of deafness and chronic suppuration. Herein lies the crux of the problem of the prevention of radical procedures. The answer is early and efficient care and treatment of the primary inflammatory episodes.

Efficient care and treatment include not only the control of infection in the nose and nasopharynx and the establishment of efficient drainage from the nasal sinuses and from the middle ear and all its communicating spaces (tubal, zygomatic, attic, mastoid and petrous). When the otitis fails to heal in a reasonable time they also include an early complete simple or modified simple mastoidectomy. As much as one may dislike to do this, it is the logical procedure. Unfortunately, even after mastoidectomy, treatment for the restoration and preservation of the hearing is often neglected, with the result that although the suppuration may finally cease, the deafness (in both ears) progresses, decade by decade, as I [2] have shown elsewhere.

In addition to the clinical effects (favorable or unfavorable) of careful treatment, serial roentgenograms are often of great service in determining the progress of the disease and therefore in determining also the advisability of operation.

Chart 2 shows fifteen audiograms taken before and after operation. This is a fair sample.

With two exceptions, the involvement in the nasal sinuses on the side of the mastoidectomy was severe and that in the mastoids was marked in or near the antrum. The pronounced involvement about the antrum no doubt was caused by the formation of dense bone following the chronic suppuration. In these chronically involved ears

2. Fowler, E. P.: The Prognosis of Moderate Deafness in Youth: Variations with Disease Management and Treatment, Tr. Am. Laryng., Rhin. & Otol. Soc. **41**:35, 1935; New York State J. Med. **36**:607 (April 15) 1936.

there appeared to be no active suppuration in the deeper cells of the mastoid. Nature had almost healed the mastoiditis and had thrown out a wall of dense bone which acted maybe as a protection for the mastoid but not for the cells immediately adjacent to the middle ear. In my

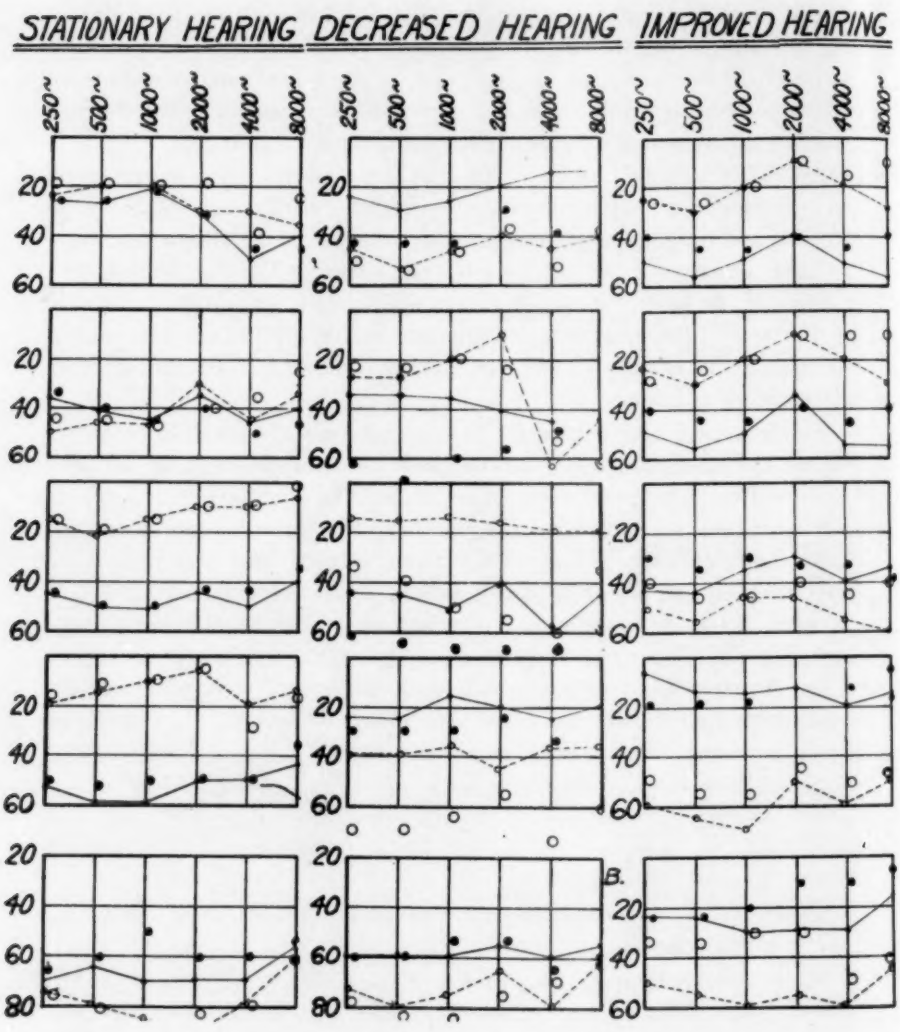

Chart 2.—Audiograms taken before and after radical mastoidectomy. In all the curves the solid dots represent the right ear and the open circles the left. The graphs before operation are represented by solid (*R*) and dotted (*L*) lines. The solid dots and circles placed slightly to the right of the ordinates represent the hearing after radical mastoidectomy. These are not connected by lines to represent the curves of hearing. The upper curve in each instance is for the better and the lower curve that for the worse hearing ear.

opinion, had an early simple operation been performed on these ears, a large majority would not have needed a radical mastoidectomy. They would have cleared up before irreparable damage had been done to the middle ear and to the hearing.

Nine mastoids which were operated on were sclerotic and six were pneumatic. The same proportion obtained also for the mastoid on the side not operated on, but the distribution did not coincide with the side on which operation had been performed.

Chart 3 shows what may at times be accomplished by persistent care and treatment of chronic suppurative otitis media when nature

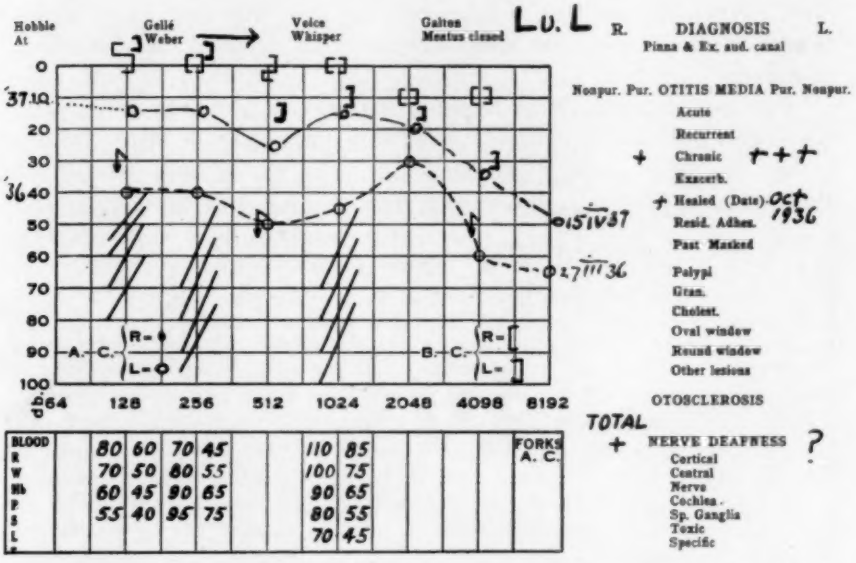

Chart 3.—Audiograms before and after treatment of a patient with chronic suppurative otitis media in the left ear and total deafness in the right ear. The diagonal lines crossing the ordinates represent the binaural loudness balance at the frequencies indicated. Because of total deafness in the right ear, the plotting for the right ear is a shadow plotting.

has thrown off the disease in the bone. In the case concerned there was a remnant of drum membrane, and no major operation was performed because the opposite ear was totally deaf (from chronic suppuration) and the patient could not afford to lose any of the remaining hearing. For many years she had constantly used a hearing aid. For the six months prior to the time of writing none has been required. Both ears have been dry for six months. They might have been dry for forty years had they been properly treated in the beginning. Notice that the hearing improved 25 db. and that bone conduction diminished

from 5 to 20 db. at the middle frequencies.[3] The reason for the happy outcome was the success in obtaining efficient drainage.

How many children with proper early care later have chronic suppurative otitis media? Very few. Many otologists will be unable to report a single case. Of course, there are many valuable aids to treatment, but the old surgical axiom, "Established efficient drainage," is of first importance. Without efficient drainage any or all of the other aids are of little value.

Chronic suppurative otitis usually begins in childhood, following the exanthems and recurrent infections of the nose and the middle ear. It can usually be prevented, with preservation of the hearing, in childhood. When it is prolonged into adult life, permanent deafness always results, and operations are then of little or no value in the restoration of hearing.

For the preservation of hearing, a simple mastoidectomy properly timed and executed is indicated in all cases in which adequate drainage is not otherwise speedily obtainable. It is time that otologists should think more of preserving the hearing than of preserving the diseased ear.

140 East Fifty-Fourth Street.

3. The oblique lines show the result of the alternate binaural loudness balance test, which in this case was done only as a routine procedure. The right ear being totally deaf, all test tones were, of course, heard only in the left ear.

SOLITARY XANTHOMA OF THE EXTERNAL AUDITORY CANAL

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The absence in the literature of any mention of the occurrence of a solitary xanthoma of the auditory canal has stimulated me to report the following case and to give a brief summary of the pertinent facts relating to xanthomatosis in general.

REPORT OF A CASE

In January 1937 a white woman aged 43 consulted me because of diminished hearing and tinnitus in the left ear of six weeks' duration, which she attributed to a cold in the head. As the cold shortly cleared up but the symptoms in the ear continued unabated, she became concerned and sought relief. She had never suffered any ailment of the ears previously.

On examination, the right tympanic membrane and the external auditory canal were found to be normal, and hearing in the right ear was normal. The left external auditory canal was blocked completely by a painless firm flesh-colored tumor, which was covered with skin and was slightly ulcerated over the presenting part, where it evidently had been traumatized by the patient in her attempts to relieve the obstruction of the ear, which she thought was due to impacted cerumen. By palpation with a fine probe, it was determined that this tumor had a broad base of attachment on the anterior wall of the canal. The left tympanic membrane could not be seen. When the Bárány noise apparatus was used in the right ear, the whispered voice was heard at 1 inch (2.5 cm.) in the left ear. Roentgen examination of the mastoid and sinuses gave essentially negative results. The urine was normal.

Although I considered this tumor benign and probably a fibroma, I advised a biopsy, which was done at St. Luke's Hospital with local anesthesia. Along with the biopsy specimen, I succeeded in removing the entire tumor, which was sessile, bled little, was about 1 by 1.5 cm. and occluded the auditory canal medially as far as the isthmus, where it presented externally and was easily visible without the use of a speculum. The left tympanic membrane was granular but intact. The surface of the external auditory canal was ulcerated in several small areas, presumably by the pressure and irritation of the mass.

The pathologic report submitted by Dr. R. Dominguez, chief of the laboratory department, was as follows:

"Section of the specimens submitted showed them to consist of small bits of skin. Stratified squamous keratinized epithelium was ulcerated in several areas. The corium was completely infiltrated by large cells with abundant pink-staining cytoplasm. In many areas this cytoplasm had a foamy appearance. Some of these

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From the Department of Otolaryngology of St. Luke's Hospital.

Read before the Clinical and Pathological Section of the Academy of Medicine of Cleveland, March 5, 1937.

large cells had coalesced to form multinucleated cells. Distributed through these masses of large cells were foci of round cells and polymorphonuclear leukocytes, and many areas in which there were new capillaries were also noted.

The final diagnosis is xanthomatous nodule, probably inflammtory."

The external auditory canal healed rapidly, and the hearing in the left ear progressively improved. One month after removal of the tumor the value for

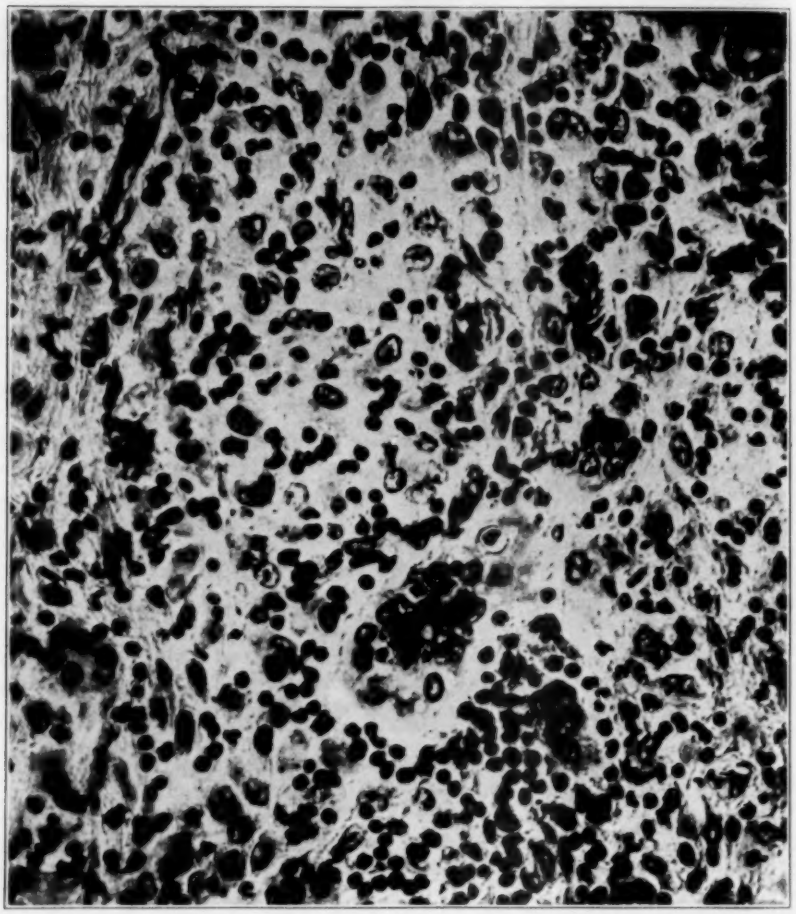

Fig. 1.—Photomicrograph of a section from the biopsy specimen, showing the typical "foamy" giant cells of xanthoma.

serum cholesterol was found to be 296 mg. per hundred cubic centimeters. The patient had no cutaneous tumors or blemishes other than some pitting of the skin of the face due to smallpox contracted at the age of 2 years. She was childless. She asserted that none of her brothers or sisters had ever had a cutaneous tumor or an operation for tumor.

The name xanthoma, meaning yellow tumor, was first used by Smith in 1869 to designate a disease which was originally described by Rayer

in 1836. Although many varieties of xanthoma have been investigated, modern workers divide them into three main types:

1. Essential xanthoma—a neoplastic disorder.
2. Xanthelasma (involving the eyelid)—a degenerative process.
3. The xanthomas associated with diabetes, jaundice and pregnancy.

The common factor in these three types is the occurrence of a fatty substance and foam cells within the lesions together with a yellow or yellowish red appearance of the lesions.

Xanthomatous lesions are of special interest to the dermatologist because of their frequent appearance on the surface of the body as xanthomatous papules, tubercles, nodules, tumors, infiltrated plaques, striae, or nonelevated, smooth, plane areas; they are of special interest to the ophthalmologist because they are on the conjunctiva and the cornea; the general surgeon and the pathologist deal with xanthomatous lesions in the tendons, lungs, spleen, skull and brain, while the otolaryngologist encounters them in the mouth, esophagus, trachea and bronchi. In this connection, I have been unable to find in the literature an instance of the occurrence of xanthomatous tumor of the external auditory canal.

As regards the etiology of xanthomatosis, the condition may be congenital or may occur at any age. It may also be hereditary. It is more often seen in the female. The discrepancy between the clinical rarity of xanthomatosis and the voluminous literature relative to it is largely explained by the growing realization that so-called essential xanthomatosis is but one member of a rather large family of related diseases. Heretofore, xanthomatosis has been largely a dermatologic entity, but recent investigations warrant its inclusion among the diseases dependent on a disturbance of the reticulo-endothelial system and of lipoid metabolism: Gaucher's disease, Niemann-Pick's disease, Schüller-Christian's disease and Tay-Sach's disease.

Various theories have been advanced to explain the development of xanthoma:

1. Xanthomatosis is probably a process of infiltration dependent primarily on hypercholesteremia and secondarily on the duration of the condition of the blood, local trauma and the local vascular supply, and it is a process of senescence and death of the cells, arrested before chemical change is complete for absorption. Arrest leads to deposition of cholesterol esters. Slight irritation or inflammation causes aggregation of cells, and this results in an increased deposit of cholesterol esters.

2. Xanthomatosis represents the body's attempt to rid the body fluids of lipoids which cannot be properly excreted and which act as an irritant, and it is characterized by two processes—storage of lipoids and proliferation of connective tissue cells.

3. Xanthomatosis is the result of derangement of the ratio of the lipid content of the blood and that of the tissue, which does not occur when there is a proportional increase or decrease of the lipids.

4. Xanthomatosis is the sequel to a disturbance of lipoid metabolism or of lipoid excretion resulting in storage of various forms of lipoid in

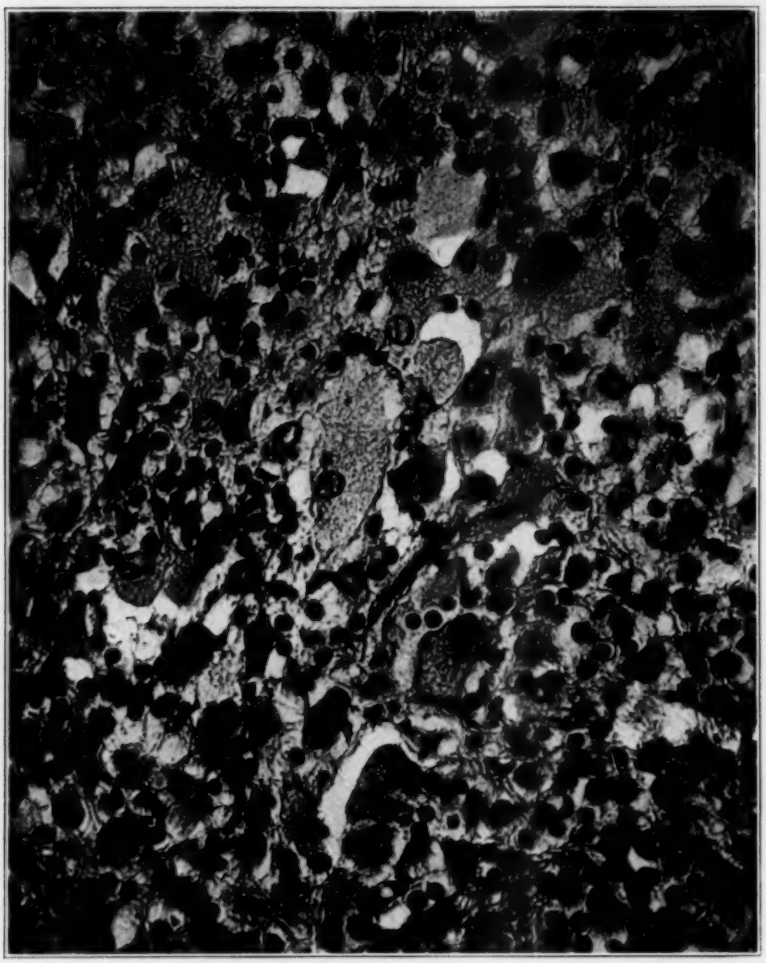

Fig. 2.—Photomicrograph of a section from the biopsy specimen.

the organs and tissues. The storage is either widespread and diffuse or localized in granulomatous deposits.

As regards the cholesterol content of the blood in xanthoma, it usually is increased but it may be normal or even reduced. It must be pointed out, however, that these facts apply only to clinically established

xanthoma, whereas research experiments indicate that hypercholesteremia accompanies the development of experimental xanthomatosis.

Histopathologically the xanthoma cell is a cell of reticulo-endothelial origin infiltrated with lipoids. In a study by Pollitzer and Wile it was found that there occurs in the earliest lesions proliferation of the cells in the immediate neighborhood of the papillary and subpapillary vessels together with an infiltration of a fatty substance into the perivascular and intercellular lymph spaces. This is present also in the new-formed cells and in the endothelium of the capillaries and here and there in the basal layer of the epidermis. These new-formed cells may contain a number of nuclei and then are considered xanthoma giant cells and on removal of their lipoid content present a reticulated, or foamy, appearance. In the connective tissue surrounding these nests of xanthoma cells fibroblasts may be present in large numbers.

CHARACTERISTICS OF MODERN ELECTRICALLY OPERATED AUDIOMETERS

A QUALITATIVE AND QUANTITATIVE ANALYSIS

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For several years various audiometers intended for general diagnostic purposes have been manufactured and sold to physicians. The early instruments were operated from batteries, but in the last few years operation from the electrical power supply circuit has become general practice. Moreover, in the last few years a number of new manufactures have begun the sale of audiometers. The increase in competitive conditions has resulted in considerable sales pressure on otologists and in extensive advertising of audiometers.

Although the value to the otologist of an accurate and otherwise satisfactory audiometer for diagnostic work is unquestioned, the attempt to form diagnoses on the basis of inaccurate audiograms can only be misleading and wasteful of time to both the physician and the patient. Audiograms taken with various commercial audiometers have not always agreed and, in fact, have been widely divergent in many cases. The question of how the various commercial audiometers compare in their relative performance and how their calibrations compare with certain basic and fundamentally accepted standards seems almost to suggest itself. The tests the data from which form the basis of this paper were undertaken to compare the performance of various commercial audiometers under the same conditions and to determine by measurements the conformity of their calibration to certain recognized principles, which will be outlined later.

For the purpose of these tests it was decided to obtain through purchase or loan audiometers of the six most widely known and advertised makes. However, it was found that one of the manufacturers, although advertising audiometers, had none for delivery, and consequently these tests were confined to the five available machines. Because

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From the Department of Otology, School of Medicine, Temple University.

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it was our purpose to make these tests only a qualitative examination of the performance of audiometers and not to condemn or justify any machine and also because we wished to prevent the use of these data for commercial advertising purposes, each audiometer as it was received was given a test number. The various audiometers will be referred to only by number, the manufacturer corresponding to each number being known only to us.

All the measurements represented by the data in this paper were taken in a sound-proof laboratory provided in the department of otology of the Temple University School of Medicine. The investigation consisted of five major parts, as follows:

1. A complete motion picture record was made of the wave forms, as shown by a cathode ray oscillograph, of the input of electrical current to the audiometer receiver and also of the wave form of the resulting output of sound pressure from the receiver, for each of the test tones provided on the audiometer.

2. Measurements were made of the attenuation of electrical currents and of sound pressure actually produced by the attenuator of the audiometer at each step from maximum to zero indicated loss of hearing for each test tone provided on the audiometer.

3. Measurements were made of the relative intensity of sound pressure produced by the audiometer receiver at the maximum indicated loss of hearing and at zero indicated loss of hearing.

4. The characteristics of the audiometer receiver were determined. Measurements were made of the relative intensity of sound pressure produced at each test tone for a constant input of electrical current. Measurements were made of the relative intensity of sound pressure produced for a varying input of electrical current at certain test tones.

5. Measurements were made of the level of intensity of the residual frequency hum from the power supply or other extraneous noise.

The arrangement of the test apparatus and the means of making the various measurements are shown diagrammatically in figure 1.

As is shown in this figure, the receiver of the audiometer was placed on a microphone cell. This microphone cell, the calibration of which was accurately known, was approximately 5 cc. in volume and formed the input device of a so-called "artificial ear," although its frequency characteristic was linear throughout the range of measurements. When a rubber cushion for the prevention of error in bone conduction was supplied with the audiometer, this was placed between the receiver and the microphone cell. A vacuum tube voltmeter was connected directly across the output terminal of the audiometer for direct measurement of the voltage input to the receiver. Either the input of electrical

current to the receiver or the output of sound pressure from the receiver, as reconverted to electrical energy by the microphone, could be fed into the amplifying system shown through impedance matching networks, which were adjusted to each audiometer. The cathode ray oscillograph could be connected directly across the electrical output terminals of the audiometer or across the output terminals of the main amplifier. The amplifier system from impedance matching network to output indicator had a flat frequency response of from 50 to 10,000 cycles per second, and the amplifier had an overall amplification of approximately 120 decibels.

The various audiometers provided many nonoctave tones, the range of tones varying from 32 to 20,000 cycles per second. As some of the machines provided odd tone ranges which would allow them to be

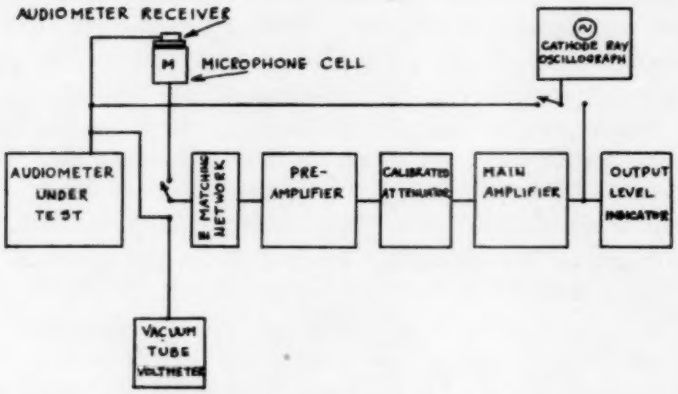

Fig. 1.—Diagram of layout of equipment for testing the audiometers.

identified, only the measurements on all the machines at the seven octave tones 128, 256, 512, 1,024, 2,048, 4,096 and 8,192 cycles are reported in this paper, although measurements were taken at every tone range provided by each machine.

The motion picture records showed that all the machines except no. 4, which will be described later, produced practically pure tones (or sine waves) at all the test frequencies. However, motion pictures were made of the oscillograph traces of the residual hum and noise in the various machines, and in these respects machine 1 was far from a desirable standard. Motion pictures were also taken of the oscillograph traces of the noises produced by slow movement of the attenuators of the machines, and these indicated that machines 3 and 5 were poor in this respect.

The intensity of sounds at the threshold of hearing over the entire range of audible frequencies has been well investigated by Fletcher

and others. Dr. Harvey S. Fletcher, in his book entitled "Speech and Hearing," showed a curve representing the intensity of sounds at the average normal threshold of hearing. The data of this curve are plotted in figure 2 for the frequencies from 64 to 8,192 cycles. As the data of this curve have been well substantiated and are universally recognized, it seems logical that the intensities of sound shown should represent the average normal threshold of hearing, or zero loss of hearing, in the calibration of any audiometer. This fact seems to have been entirely overlooked by some audiometer manufacturers, as will be shown.

Further examination of the curve for Fletcher's data in figure 2 shows, as is well known, that the intensity of sound necessary to pro-

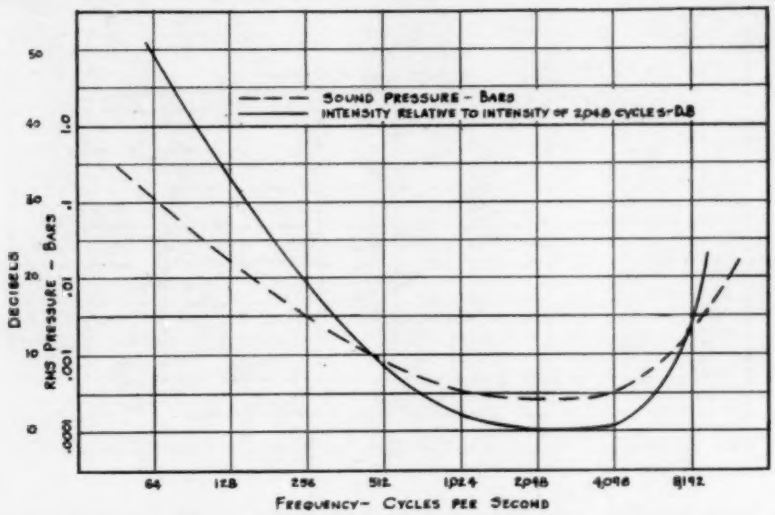

Fig. 2.—Relative intensity of sounds at the threshold of audibility (from data by Fletcher).

duce hearing at the average normal threshold is lowest at approximately 2,048 cycles; that is, the greatest acuity of hearing in average normal ears is at this frequency. Each frequency above or below 2,048 cycles requires a greater intensity of sound to produce the normal threshold. From the curve representing the average normal threshold it can be seen that the intensity of each of the other tones is in a fixed relation to the intensity of 2,048 cycles. In figure 2 a curve is shown of the relation in decibels of the intensity of the other sounds to the intensity at 2,048 cycles at the average normal threshold. It seems obvious that in a properly calibrated audiometer the intensities of the various sounds at the indicated threshold of hearing, or at the position indicated for zero loss, should be in the relationship to the intensity of

2,048 cycles shown by this curve. However, this relationship did not exist in some of the audiometers tested.

In figure 3 the relationship of the intensities of the various test tones at the position indicated for zero loss of hearing on the several audiometers tested is shown. The intensities are plotted in decibels with reference to the intensity of the 2,048 cycle tone. The dotted curve in this figure shows the relationship as it should be according to Fletcher's data plotted in figure 2. As can be seen from examination of the curves, there is considerable deviation for some of the audiometers. No one of the audiometers was within an assumed allowable 5 decibels of the correct relationship at every frequency, although audiometer 2 did come within this tolerance, except at 128 cycles.

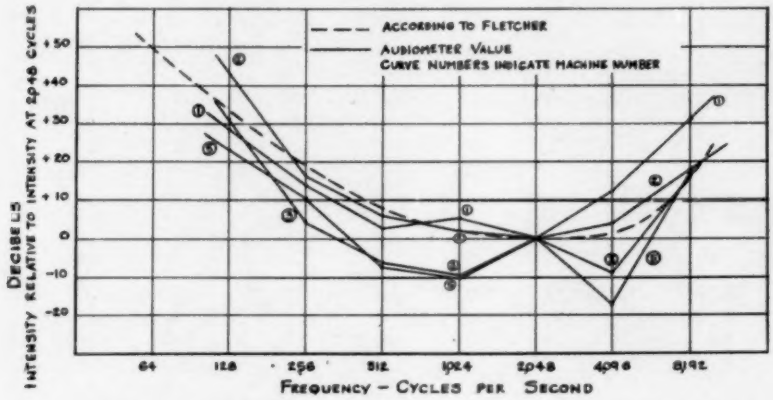

Fig. 3.—Intensity of sound at indicated threshold (zero loss of hearing).

Both audiometer 3 and audiometer 5 at some of the frequencies had sound intensities lower than that of 2,048 cycles by as much as 15 decibels.

No data are plotted for audiometer 4. The oscillograms of the wave forms of the various tones of audiometer 4 showed that the supposed "tones" were simply noise of every character and had no true wave shape. No "tone" produced consisted of as much as 40 per cent of any fundamental frequency.

No calibration of any kind, either for octave tones or for loss of hearing, was provided on the machine. Simply arbitrary numbers were represented, which could not be correlated into any system of units. How it was expected that this machine could be used to indicate loss of hearing is beyond the comprehension of any person who examined it. For these reasons no data are plotted in the various figures for audiometer 4.

In figure 4 are plotted the measured relative intensities of sound of the various audiometers at the position indicated for zero loss of hearing and at the position indicated for maximum loss of hearing for each of the test tones. As is shown in the figure, all the audiometers provided, within a range of 10 decibels, approximately the same maximum intensity to represent the maximum loss of hearing at the five lower tones, 128 cycles to 2,048 cycles, inclusive. At the two high frequencies, 4,096 and 8,192 cycles, audiometers 2 and 3 were still in close agreement but audiometers 1 and 5 diverged widely from the previous intensities.

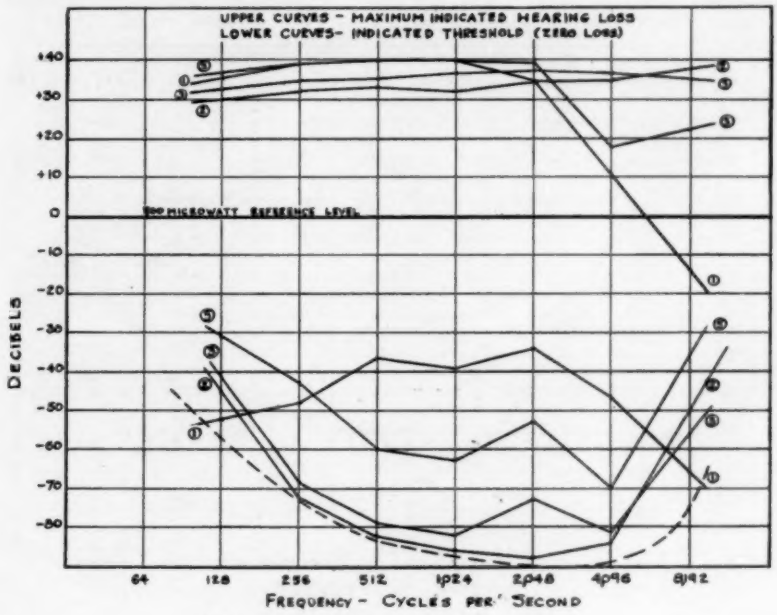

Fig. 4.—Relative intensities sound.

Although there was some reasonable agreement among the audiometers on the intensity at maximum indicated loss for at least the five lower tones, there was unfortunately no such agreement on the intensity at the position indicated for zero loss. As previously stated, the intensities of sound which correspond to zero loss of hearing in an audiometer should be in accordance with the intensities given by Fletcher for the average normal ear. Reference to the lower curves of figure 4 shows how far away from the theoretical ideal some of the audiometers were. The dotted curve shows the relative intensities as given by Fletcher plotted to the same reference level. As is shown, only audiometers 2 and 3 approached the proper intensities for the

threshold, or zero loss condition, and even these were in error by some 17 decibels at 8,192 cycles. Audiometers 1 and 5 are so far away from the correct intensities for the threshold, or zero loss condition, as to make their readings almost worthless for comparative purposes.

There does not seem to be any compromise from the fact that every audiometer should have sound intensities for the position indicated for zero loss at every frequency which correspond with at least reasonable accuracy to the recognized intensities at the average normal threshold of hearing.

How far the calibration for loss of hearing should be carried for each tone, that is, how great a range of loss of hearing in decibels

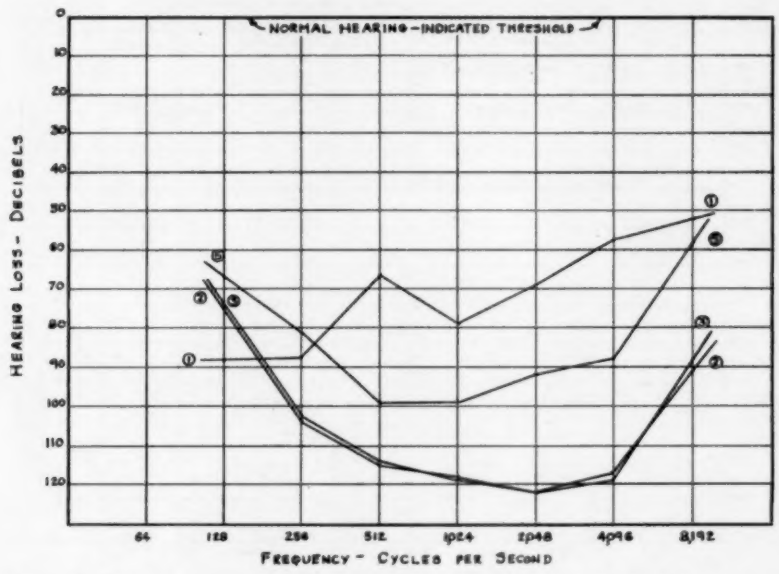

Fig. 5.—Dynamic range of loss of hearing (calibrated loss of hearing corrected for errors of the attenuator).

should be indicated, is a matter which, in the absence of any standardization, audiometer manufacturers have decided differently for themselves. In figure 5 is shown what we have called the "dynamic range of loss of hearing," that is, the relationship of the intensity of the sound at the greatest indicated loss to the intensity of the sound produced at zero indicated loss. A curve is plotted for the calibrated values for each machine. As becomes obvious on inspection of the figure, there is little agreement on what the dynamic range should be, except for audiometers 2 and 3, which are in close agreement.

In the absence of standards, there is of course no guide as to what the indicated range of loss of hearing should be. Even recently pro-

posed standards have made no provision for standardization on this point. It is our opinion that just as the intensities indicated for zero loss of hearing should correspond to the recognized intensities at the threshold of audibility, so the intensities at the calibrated indication for maximum loss should have some definite relationship to the average normal threshold of feeling.

Aside from incorrect reference intensities, the greatest errors in the audiometers tested were in the attenuator or in the calibration of the attenuator. The actual steps in the attenuation of sound intensity and also of the input of electrical current to the receiver were checked

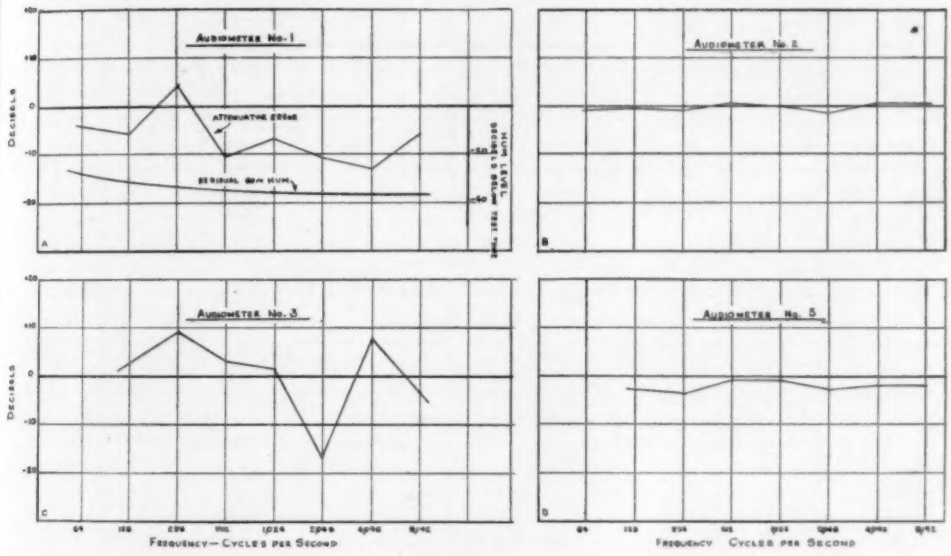

Fig. 6.—Audiograms taken with the various audiometers tested.

for each audiometer. In some of the audiometers the calibrated intensity deviated considerably from the actual values. This was found to be due either to improper matching of the dial scale to the steps of the attenuator or else to irregularity of steps, instability of the attenuator or actual inaccuracy of the calibrated range in decibels. A contributing source of error was found in that some of the manufacturers calibrated their audiometers almost entirely on the basis of input of electrical current to the receiver, whereas it was found that the intensity of sound pressure of the output from the receiver did not always follow the intensity of the input of electrical current, particularly at sounds of high intensity, at which saturation of the receivers seemed to take place.

Figure 6 shows the errors found in the various audiometers for the total range of the attenuator at each test tone.

On the chart showing the error in calibration of the attenuator for audiometer 1, shown in figure 6 *A*, is also plotted the level of intensity of a residual 60 cycle hum measured in this machine. As will be noted, the intensity of this hum was only 35 to 40 decibels below the level of maximum intensity of the test tone. It could be heard distinctly and made the identification of the test tone cut off difficult at hearing losses of 20 decibels or less.

The intensity of the hum in all the other audiometers for which data are plotted was at least 60 decibels below the intensity of the test tone.

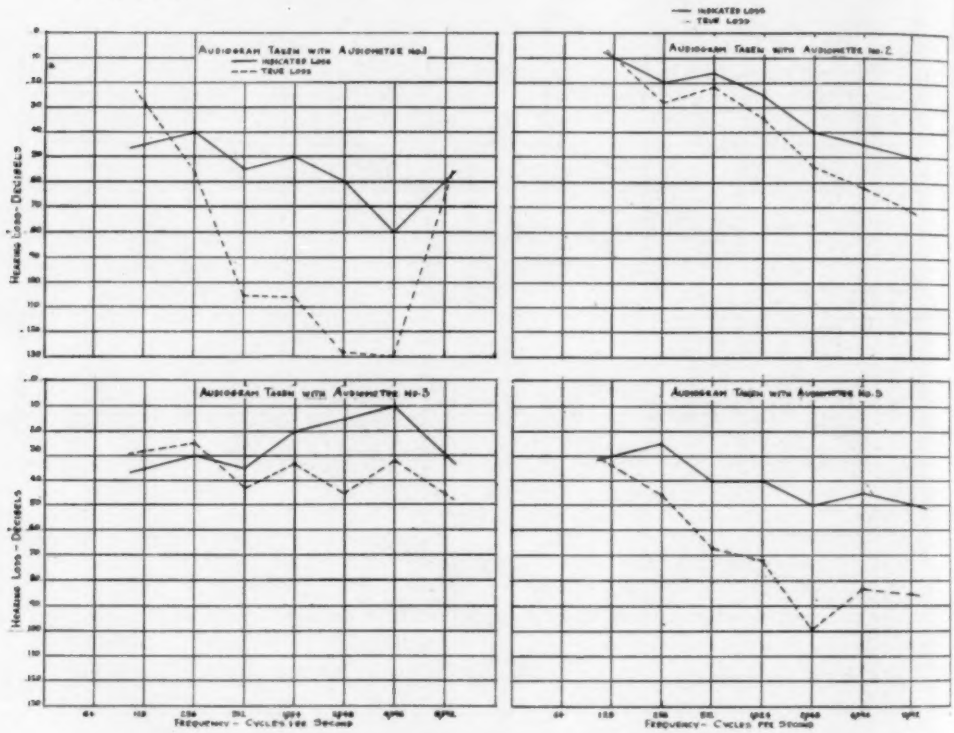
INDICATED LOSS
TRUE LOSS
AUDIOGRAM TAKEN WITH AUDIOMETER NO. 1
AUDIOGRAM TAKEN WITH AUDIOMETER NO. 2
AUDIOGRAM TAKEN WITH AUDIOMETER NO. 3
AUDIOGRAM TAKEN WITH AUDIOMETER NO. 5
HEARING LOSS - DECIBELS
FREQUENCY - CYCLES PER SECOND

Fig. 7.—Errors in calibration of the attenuators.

In the testing of audiometers observations were made on the general performance and stability of the various machines. These data do not lend themselves to graphic presentation and are consequently given as follows:

Audiometer 1 showed: 1. A residual hum was present, as previously noted. 2. The various test tones could be noticed audibly from some vibrating element within the cabinet, even when the ear receiver was disconnected. The intensity was approximately the same as that which was produced by the receiver at an

indicated loss of hearing of 20 decibels. 3. The attenuator loss of hearing calibration was covered with multiple, overlapping scales. When the scale was shifted from one range to the next at certain points, the overlapping calibrations of the same loss of hearing did not give the same intensity of sound output. This error was as much as 10 decibels for some frequencies.

The attenuator on audiometer 3 was the noisiest and the most unreliable of all those inspected on the various machines. The steps were not accurate, skipping steps in intensity by as much as 10 decibels at certain points. This attenuator would not always repeat readings for loss of hearing at the same settings and created a great deal of frying noise even when not being moved. Aside from the attenuator, this was an excellently constructed machine and probably all the errors

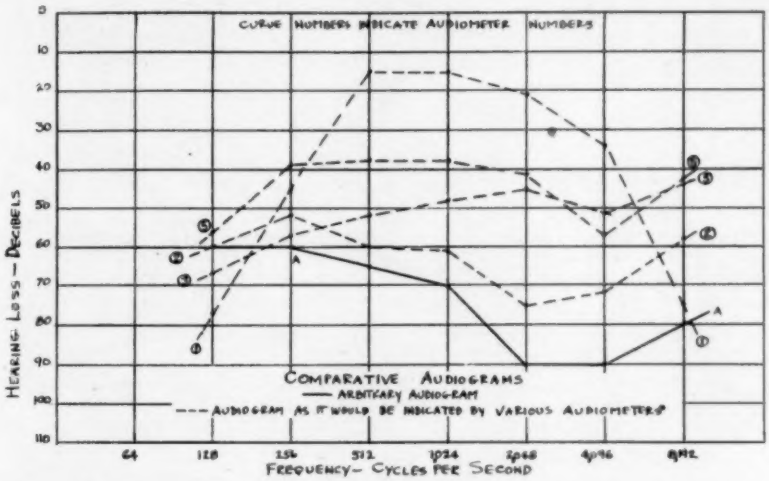

Fig. 8.—Comparative audiograms taken with the various audiometers.

found were due only to the poor attenuator. It seems unfortunate that what would easily be the best machine available should be spoiled by the desire to cut cost on so important a part as the attenuator.

Audiometer 5, even though it was provided with an indicator with which it was intended that the voltage of the supply current be adjusted to the normal point, fluctuated rapidly in intensity of output for a constant setting at an indicated loss of hearing. This fluctuation amounted to a change in intensity of as much as 15 decibels over a period of five minutes at certain times. The attenuator of this machine produced violent clicks when adjusted. The intensity of the sound produced by these clicks was several times that of the test tone and produced considerable confusion, particularly in the lower range of loss of hearing.

Audiograms were taken with each machine. Assuming that the intensity at the average normal threshold given by Fletcher should

represent zero loss of hearing, the errors found in the previously discussed figures both for incorrect reference level and for errors in calibration of the attenuator for each machine were taken into account, and the audiograms taken with the respective machines were corrected for the errors found. Figure 7 shows these audiograms as taken and as corrected for each machine.

In figure 8 an arbitrary audiogram, assumed to be true, is given and the audiogram as it would be indicated by each of the machines, without correction for any errors, is shown.

If the percentage loss is calculated from the comparative audiograms shown in figure 8, the percentage loss indicated is that shown in the following tabulation:

Audiometer No.	Indicated Percentage Loss of Hearing
1	13.84
2	52.48
3	48.30
5	31.02
Assumed audiogram	59.20

The great variation in the indicated percentage loss for the various audiometers is evident. Audiometers 2 and 3 show a reasonable accuracy for this type of indication, whereas the readings for audiometers 1 and 5 deviate so greatly as to be worthless.

CONCLUSIONS

The errors found in the audiometers tested in this investigation are due, in general, to the following causes:

1. Lack of proper standardization and a central calibrating agency.

Otologists have the right to expect that an audiometer sold for diagnostic purposes should be calibrated in accordance with fundamental known auditory characteristics. They have not, however, provided final standards and tolerances with which manufacturers of audiometers may be guided. Recently proposed standards fall far short of the ideal in that they do not in any way define what should be the basic and absolute primary standard.

2. The attempt to build instruments for diagnostic measurements to a price rather than to a performance standard.

3. The almost total ignorance or neglect of some audiometer manufacturers of the known and published physiologic and auditory characteristics of the human ear.

1915 Spruce Street.

PNEUMOTHORAX COMPLICATING TRACHEOTOMY IN FULMINATING LARYNGOTRACHEO-BRONCHITIS

REPORT OF A CASE

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MEMPHIS, TENN.

Complications resulting from or coincident with tracheotomy are unusual. Emphysema of the subcutaneous tissues may occur, and possibly air may extend into the mediastinum and rarely into the pleural cavity. Suturing of the tracheotomy wound really is of no value and may cause or aggravate an emphysematous condition.

Kahler,[1] in his study of the literature, found only two cases of perforating injury resulting from bronchoscopy. Both accidents occurred in small children. In one case there was collapse of the lung due to an injury to the pleura by the bronchoscope. In the second case there was emphysema of the body from head to foot resulting from the injection of silver nitrate through the bronchoscope; the child recovered in a few days.

Imperatori[2] reported a case of pneumothorax complicating bronchoscopy and later did experimental work on animals showing the effect of puncture of the bronchus, mediastinum and pleural cavity by the bronchoscope and other instruments.

Myerson[3] reported a case of bilateral pneumothorax resulting from tracheotomy.

Iglauer[4] reported a case of pneumothorax complicating tracheotomy, with recovery. He explained the manner in which the pneumothorax took place by quoting Champney as follows: "If the larynx is obstructed and during the tracheotomy one makes a small nick in the pre-tracheal fascia and lifts the fascia away from the trachea, the patient may draw air into the mediastinum during inspiration. If the inspiratory effort

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From the Department of Otolaryngology of the University of Tennessee.

1. Kahler, O.: Gefahren und Schäden bei der Tracheobronchoskopie, Deutsche med. Wchnschr. **61**:2081 (Dec. 27) 1935.

2. Imperatori, C. J.: Sudden Death During Bronchoscopy: A Preliminary Report of a Physiological Study, Laryngoscope **26**:1257, 1916.

3. Myerson, M. C.: Perforation of the Bronchus with Notes on Bronchoscopic Anatomy, Tr. Am. Bronchoscop. Soc., 1932, p. 65.

4. Iglauer, Samuel: Accidental Pneumothorax During Tracheotomy with Report of a Case, Ann. Otol., Rhin. & Laryng. **24**:303, 1915.

is very violent, the air may rupture from the mediastinum into the pleural sac." The pneumothorax of Iglauer's patient was shown in a roentgenogram taken after the operation. The child finally recovered. Iglauer stated that there is also a possibility that one may nick the dome of the pleura in doing a low tracheotomy, but this is a remote possibility, and he expressed the belief that it did not occur in his case.

Wiethe [5] reported two cases of pneumothorax connected with tracheotomy. The patients were children, aged 4 and 6 years. In the first case the original malady was high grade subglottic laryngitis; in the second case operation was performed because of papilloma. During exposure of the trachea in the first case there were sounds suggesting aspiration of air into a vein. Not until the opening of the trachea and the introduction of a cannula was it discovered that the child was cyanotic in spite of elimination of the respiratory hindrance. The same was true in the other case. In both cases the presence of complete pneumothorax on the left was determined. Neither child suffered permanent injury from this complication, because it was unilateral in each instance and the children had healthy hearts. The condition disappeared in a few days.

Wiethe made roentgenograms of a child with a movable foreign body in the trachea and found that when the foreign body was thrown against the subglottic region, interfering markedly with expiration, there was considerable elevation of the domes of the pleura, which brought them to a height well above the clavicle and of course made them more readily injured by tracheotomy. Wiethe also emphasized the fact that when the head is markedly retroflexed the pleural domes are higher than usual.

In a search of the literature I have not found a case of pneumothorax complicating tracheotomy or bronchoscopy associated with laryngotracheobronchitis.

Laryngotracheobronchitis necessitating intubation or tracheotomy or possibly bronchoscopy for the removal of crusts may be of the mild or of the fulminating type. In the cases reported by Lynch [6] the condition was mostly of the mild type, caused by a staphylococcus, while in most of those reported by Jackson, Richards,[7] Baum,[8] Gittens,[9]

5. Wiethe, Camillo: Ueber Pneumothorax bei Tracheotomia inferior, Monatschr. f. Ohrenh. **67**:57, 1933.

6. Lynch, R. C.: Potpourri, Laryngoscope **34**:753, 1924.

7. Richards, L.: Fulminating Laryngo-Tracheo-Bronchitis, Tr. Am. Bronchoscop. Soc., 1933, p. 55.

8. Baum, H. L.: Acute Laryngotracheobronchitis, J. A. M. A. **91**:1097 (Oct. 13) 1928.

9. Gittens, T. R.: Laryngitis and Tracheo-Bronchitis, Tr. Am. Bronchoscop. Soc., 1936, p. 122.

Berry,[10] and others the condition was more fulminating, usually having a streptococcus as the invading organism. In either type the tenacious inspissated bronchial secretion may act as a foreign body after the tracheotomy, blocking off the airway, and may have to be removed by means of a bronchoscope, forceps or suction. Baun expressed the belief that tracheotomy augments and intubation inhibits the formation of bronchial crusts.

In many cases after the tracheotomy all that is necessary to remove the secretions from the bronchi and trachea is suction with a rubber catheter. This procedure can usually be carried out by the nurse. If the secretion is tenacious and cannot be removed by means of the catheter, it soon dries and acts as a foreign body, and if the crusts are of sufficient size and so located as to cause air hunger, it is necessary to remove them. Often only one or few removals are necessary, while in an occasional case this procedure must be carried out many times.

The following case came under my observation:

A boy 14 months old was brought to the hospital with acute laryngotracheobronchitis of less than twenty-four hours' duration. He was already having difficult breathing with slight cyanosis. This was at midday. A tracheotomy was done within the hour, a bronchoscope being used as an airway and procaine hydrochloride as the anesthetic. There was no bleeding necessitating ligature of the vessels, and there was little struggling of the child during the operation.

The little fellow did nicely for about twenty hours, at the end of which time air hunger developed. A bronchoscopy was done, and a moderate amount of dried secretion was removed from the left main bronchus. There was some relief, but he continued to be restless, breathing less satisfactorily than is usual after such a procedure. A roentgenogram was taken and showed pneumothorax of the right side. About two hours before the bronchoscopy was done, when the patient was seemingly in a satisfactory quiet condition, the chest was examined and air was found to be going normally into each lung.

During the next six days about fifty bronchoscopies were done. The patient was kept at one end of a bed and the bronchoscopic instruments at the opposite end. When air hunger and cyanosis developed, the bronchoscope was inserted and the crusts and secretion were removed with a forceps, by suction or by some other means.

About the third day the right lung was filling well, and as the pneumothorax of the right side disappeared, crusts began forming in the right main bronchus, necessitating their removal. After eight days further bronchoscopy was unnecessary. Material from the bronchi showed a pure culture of staphylococci. Of course, it showed no diphtheria bacilli.

The presence of pneumothorax in this case of laryngotracheobronchitis with so much secretion, crusts, etc., made the child's recovery much more difficult than if both lungs had been functioning. Several

10. Berry, G.: Membranous Laryngitis and Tracheitis with Staphylococcus Aureus-Hemolyticus Infection, Tr. Am. Bronchoscop. Soc., 1928, p. 35.

times while the pneumothorax on the right was at its height and the symptoms of large crusts in the left main bronchus arose, the patient's condition was critical. Even under oxygen it was barely possible several times to get the airway cleared soon enough to save his life.

During the entire course of this condition the child was urged to drink freely of water, fruit juices and other fluids, which he was able to do. The recovery was uneventful, and the tracheotomy tube was removed in about two weeks.

CONCLUSIONS

Tracheotomy and bronchoscopy are often life-saving procedures in laryngotracheobronchitis.

Pneumothorax is a serious complication in laryngotracheobronchitis, necessitating tracheotomy and bronchoscopy, but with the use of oxygen and careful thorough attention many patients may be saved.

A VEGETABLE FOREIGN BODY ENCAPSULATED IN A VOCAL CORD

REPORT OF AN UNUSUAL CASE

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AND
HERRMANN E. BOZER, M.D.
BUFFALO

It is uncommon for foreign bodies to be embedded in the vocal cords. Encapsulation of a vegetable foreign body in a vocal cord is rare. It is for this reason that the following case is reported.

G. S., a white man of 40, was admitted to the Buffalo City Hospital on Feb. 2, 1932. He stated that about three years before he noticed that his voice was becoming hoarse. Since that time his hoarseness had undergone irregular periods of exacerbation and remission until one year previous to his admission, when it became constant and severe. He stated that during the year prior to admission he had on occasions felt "gagged," and had found it necessary to whistle before he could speak. Past illnesses and other functional history were irrelevant to the present communication. It is interesting to note, however, that the senior medical student who recorded the patient's history but did not examine the larynx elicited information which evidently impelled him to write as his clinical impression of the case that of "possible obstruction or foreign body in the larynx," in addition to chronic laryngitis and pharyngitis.

Examination by indirect laryngoscopy revealed a large pale, shining polypoid structure in the anterior commissure of the larynx. This was slightly movable and could be seen moving up between the vocal cords on expiration. Its free end was slightly nodular. The vocal cords presented the appearance seen in chronic laryngitis. Complete physical examination otherwise gave negative results. The polypoid structure was removed by one of us (H. E. B). Recovery was uneventful, and the patient was discharged with good vocal function.

The gross pathologic specimen consisted of soft blue-pink tissue and measured roughly 0.5 by 1 cm.

The microscopic sections were bordered for the most part by epithelium composed of columnar, indian-club-shaped and pyriform cells, mostly in a single layer, but in some situations three or four cells in thickness. The nuclei were large, ovoid and deep staining with hematoxylin. In one situation, the epithelium was defective. A basement membrane was present throughout.

In the subepithelial stroma there was a rectangular golden yellow structure, obviously of vegetable tissue. This was divided into many small square cells, the walls of which possessed cross-striations. In the collection of botanical slides at our disposal in the Buffalo Museum of Science, that of the epidermis of a wheat grain resembled the architecture of the vegetable tissue.

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There was a clear space around this structure, apparently due to edema. One giant cell of the foreign body type was in relation to it. A few histiocytes were scattered about. The area was remarkably free from inflammatory reaction. The adjacent tissues were composed of a light, pink-staining (with hematoxylin and eosin) stroma. The central part of this area presented a fine fibrillar network of reticulum (with a Bielschowsky silver impregnation) and a few collagen

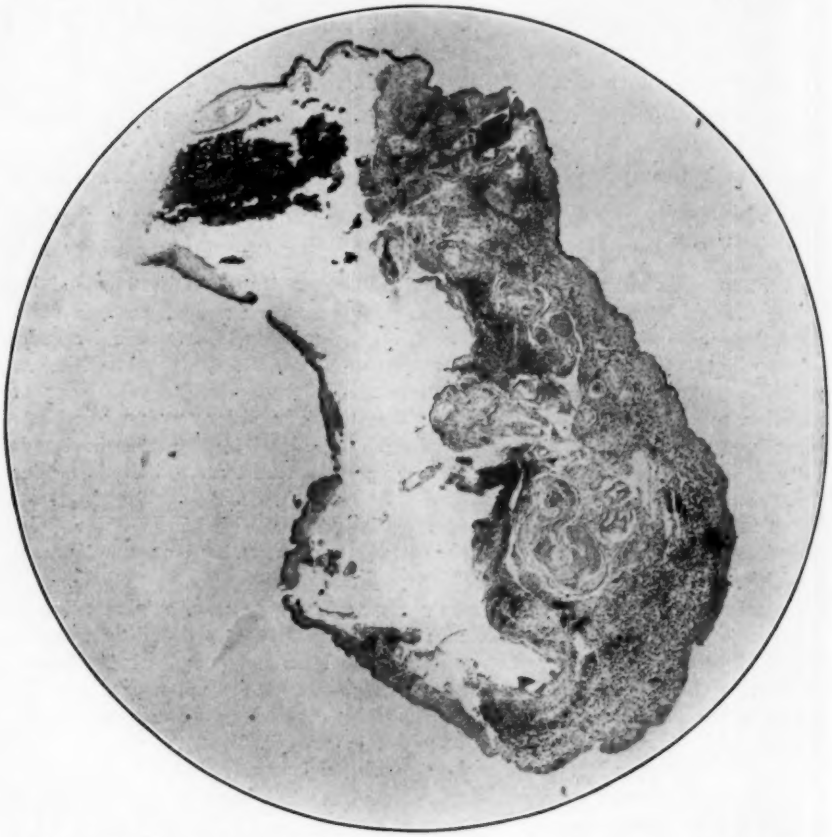

Fig. 1.—Photomicrograph of the biopsy specimen (12×). The vegetable foreign body is in the upper left quadrant. The dark granules are histiocytes laden with hemosiderin. Note the organizing old venous thrombosis and the general inflammatory reaction. The large cleft is largely due to an artefact.

fibers (with a Masson trichrome stain). Large histiocytes were scattered throughout this area. The cytoplasm of these was distended with fine granules of golden brown pigment. These were seen in unstained sections and in those stained with hematoxylin and eosin. In the Bielschowsky preparations they were not stained at all, while with a Mallory Turnbull blue preparation they stained a deep blue. Since particles of carotene are soluble in alcohol, their persistence in tissue which has been carried through paraffin embedding and then through deparaffinization

establishes that they were not granules of carotene, which one might reasonably have assumed them to be. The positive reaction to Turnbull's blue distinguishes them as hemosiderin.

In the area in which the histiocytes predominated two large veins presented definite evidence of organization with recanalization, such as is commonly found after thrombosis. A moderate number of other blood vessels were present. These were not especially remarkable.

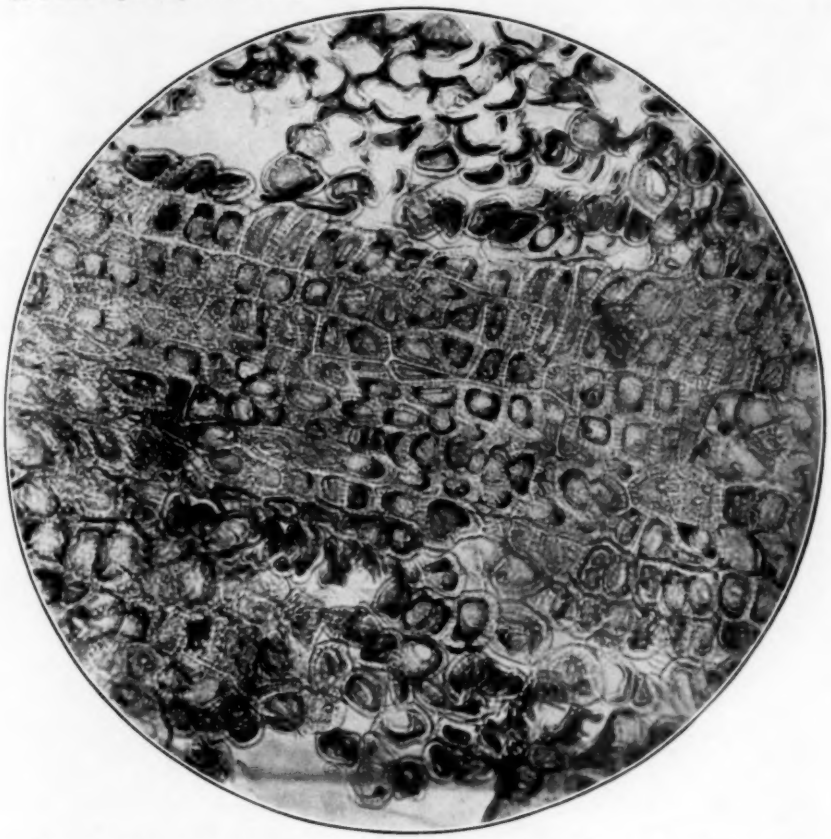

Fig. 2.—Photomicrograph of vegetable foreign body (260 ×). The structure is similar to that of the epidermis of a grain of wheat.

COMMENT

In reviewing the articles listed in the *Quarterly Cumulative Index Medicus* we could find no report of a vegetable foreign body in the tissues of the larynx, but we believe that other cases may have existed, and either have not been detected or if detected have not been reported. The foreign body in the present case might have been overlooked if chance had not been responsible for its being sectioned in the first slides presented for routine study.

This patient was accustomed to working in the fields in the summer. It is probable that on one of these occasions a sharp bit of vegetable matter was aspirated forcefully into the larynx, penetrating the mucosa. Movements of the larynx could have facilitated its deeper penetration. Such penetration of tissues by foreign bodies with movements of muscle is well recognized in other parts of the body. Thrombosis of veins occurred. This may have been due either to the foreign body or to the combination of its presence and an exacerbation of the chronic laryngitis. At any rate, interstitial hemorrhage developed. This became partly organized, and the thrombosed veins became recanalized. The only evidence of interstitial hemorrhage is the presence of histiocytes laden with hemosiderin.

The patient did have chronic laryngitis. It is generally accepted that exacerbations of chronic laryngitis do cause hyperemia and edema and also an increase in the size of papilloma and granuloma. To repeated exacerbations in this case, we attribute the development of the polypoid structure seen on laryngoscopy.

The absence of a chronic inflammatory reaction and the small amount of reaction to the foreign body are worthy of notice, because usually these are well developed.

CONCLUSION

An unusual case of vegetable foreign body embedded in the tissues of the larynx is described. So far as we have been able to determine, it is the first to be reported. The microscopic features are described and discussed.

RÔLE OF HELIUM IN CASES OF OBSTRUCTIVE LESIONS IN THE TRACHEA AND LARYNX

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AND
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The inhalation of helium to relieve obstructive dyspnea is based on the molecular lightness of this gas in comparison to nitrogen.[1] A mixture of 80 per cent nitrogen and 20 per cent oxygen is three times as heavy as a mixture of 80 per cent helium and 20 per cent oxygen. According to Graham's law, the rate of diffusion of a gas is inversely proportional to the square root of its density. This law applies also to effusion, i. e., the passage of a gas through small orifices, which is especially applicable to the problem here discussed. Since the viscosity of helium is slightly greater than that of nitrogen, there is no reduction in frictional resistance, and Poiseuille's law does not become involved in an explanation of the results. The point involved is that the obstruction exists for a space so limited in extent as to obey the law of diffusion or effusion rather than Poiseuille's law. Under these circumstances the pressure required for moving a mixture of helium and oxygen would be approximately one-half that required for moving air.

Wherever there is obstruction to the movement of air in the respiratory tract, increased pressure is necessary to transport a volume of air to and from the lungs. If the obstruction is severe the respiratory musculature, even at maximal effort, becomes unable to ventilate the lungs with a volume of air sufficient to maintain respiratory function.

Read at the Fifty-Ninth Annual Congress of the American Laryngological Association, Atlantic City, N. J., June 2, 1937.

From the Department of Medicine, College of Physicians and Surgeons, Columbia University, and the Nose and Throat Department, Presbyterian Hospital.

1. (*a*) Barach, A. L.: Use of Helium as a New Therapeutic Gas, Proc. Soc. Exper. Biol. & Med. **32**:462 (Dec.) 1934; (*b*) Use of Helium as a Therapeutic Gas, Anesth. & Analg. **14**:210 (Sept.) 1935; (*c*) Effects of the Inhalation of Helium Mixed with Oxygen on the Mechanics of Respiration, J. Clin. Investigation **15**:47 (Jan.) 1936; (*d*) Use of Helium in the Treatment of Asthma and Obstructive Lesions in the Larynx and Trachea, Ann. Int. Med. **9**:739 (Dec.) 1935; (*e*) Rare Cases Not Essential to Life, Science **80**:593 (Dec. 21) 1934; (*f*) The Therapeutic Use of Helium, J. A. M. A. **107**:1273 (Oct. 17) 1936. (*g*) Barach, A. L., and Martin, John D.: Effect of Inhalation of Oxygen Under Positive Pressure on Pulmonary Congestion and Edema, J. Clin. Investigation **15**:466 (July) 1936.

The substitution of helium for nitrogen then provides a respirable mixture which may be breathed with a pressure theoretically almost one-half that necessary for breathing either oxygen or air. It has been shown that human subjects can breathe through a narrow orifice with from 35 to 50 per cent less pressure when a mixture of helium and oxygen is inhaled instead of either air or an atmosphere of 100 per cent oxygen.[1a] This saving in respiratory effort was further confirmed by experiments in which animals breathed against resistance; it was shown that a smaller intrapleural negative pressure was necessary when animals respired mixtures of helium and oxygen instead of air.[1c] As experimental and clinical evidence accumulated it became evident that the addition of small positive pressures to the respired mixture of helium and oxygen made even more effective the relief of dyspnea; the atmosphere gently inflated the lungs by pressure from without instead of being sucked in by marked contraction of the muscles of inspiration. The literature revealed that much work on this angle of the subject had already been done, although only sporadic attempts were initiated to make clinical use of this concept.

The pathologic consequence of unrelieved respiratory obstruction, in either the larger or the smaller air passages, is the development of congestion and edema in the lung. Moore and Binger [2] found that these changes took place when dogs were subjected to inspiratory obstruction alone, whereas they did not occur when the animals only expired against resistance. We have confirmed these observations and have shown that it is the negative pressure which is induced within the chest during inspiration against a restricted orifice that is the significant factor. When dogs were made to inspire against a negative pressure of 4 cm. of water for six hours, produced by putting a weight on the counterpoise of a basal metabolic apparatus, a progressive rise in the intrapleural negative pressure was found, whereas a similar experiment in which a positive pressure was applied during the expiration resulted in only slight changes in the intrapleural pressure. The pathologic changes in the lungs were minimal in the case of expiration against resistance or against pressure, whereas severe pulmonary congestion and edema, at the hilar and basal regions of the lung, with emphysema at the periphery, were found when inspiration was conducted against resistance or negative pressure. (Unpublished photomicrographs showing

2. Moore, R. L., and Binger, C. A. L.: Observations on Resistance to the Flow of Blood to and from the Lungs, J. Exper. Med. **45**:655, 1927; The Response to Respiratory Resistance: A Comparison of the Effects Produced by Partial Obstruction in the Inspiratory and Expiratory Phases of Respiration, ibid. **45**: 1065, 1927.

the changes due to inspiratory dyspnea are shown, together with charts illustrating the progressive increase of the intrapleural pressure.)

The influence of the pathologically elevated negative intrapleural pressure in cases of respiratory obstruction, which may be from seven to ten times the normal value, as Barach observed both in animals subjected to tracheal stenosis [1] and in a patient with asthma,[1] is primarily to exert a suction action on the pulmonary capillaries.

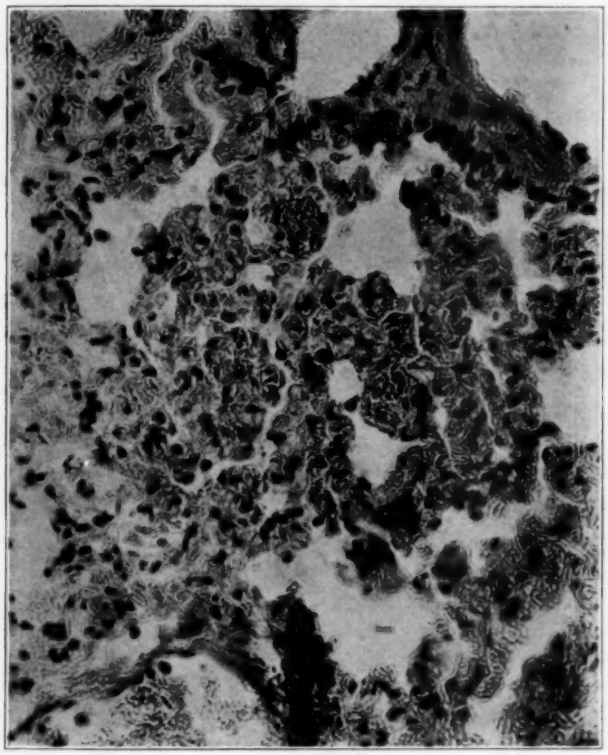

Fig. 1.—Photomicrograph showing marked passive congestion in pulmonary capillaries at the base of the lung, produced by inspiring against negative pressure.

This "cupping action" on the capillaries lining the alveolar and bronchiolar walls, which makes for the exudation of serum, is only one effect of the altered mechanics of ventilation of the lungs. The effect of increased negative pressure within the chest has been shown to be an augmentation of pulmonary and peripheral blood flow (Daly [3] and

3. Daly, I. de Burgh: The Resistance of the Pulmonary Vascular Bed, J. Physiol. **69**:246, 1930.

Møllgaard [4]). Huggett [5] found that when inspiratory obstruction was produced in a cat a marked increase in the minute volume and the stroke volume of the heart took place, whereas expiratory obstruction produced the reverse effect. Thus, the first effect of increased negative chest pressures is to reduce the resistance of the flow of blood through the lungs; in addition, the dilating effect of the negative pressure on the right auricle and ventricle may increase the diastolic volume. How-

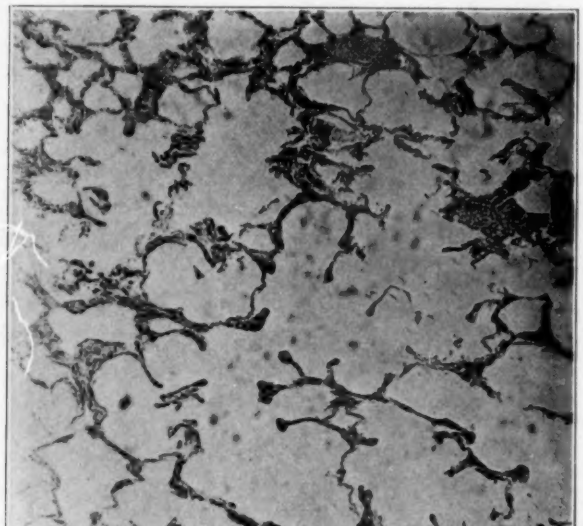

Fig. 2.—Photomicrograph showing areas of emphysema at the periphery of the lung, produced by inspiring against negative pressure.

ever, the end-result of inspiratory obstruction is not only congestion and edema in the lung but also circulatory failure.

In order to provide an additional physiologic basis for the concept of positive pressure as a helpful therapeutic factor in the treatment of respiratory obstruction, a brief historical review of the use of positive

4. Møllgaard, Holger: Fysiologisk lungekirurgie, Copenhagen, Gyldeirdalska Boghandel, 1915, p. 371; quoted by Tigerstedt, R. A. A.: Die Physiologie des Kreislaufes, Berlin, W. de Gruyter & Co., 1923.

5. Huggett, A. St. G.: Studies on the Respiration and Circulation of the Cat, J. Physiol. **59**:373, 1925.

pressure in the treatment of experimental pulmonary edema seems pertinent. Haven Emerson [6] (1909) showed that pulmonary edema produced in a rabbit by the intravenous injection of epinephrine hydrochloride cleared up when artificial respiration was carried out through a tracheotomy tube, the lungs being gently distended and allowed to collapse. He believed that full expansion of the lungs, which were distended from within, aided the circulation by forcing blood onward from the lungs into the left auricle and ventricle. His reasoning was in line with the postulate of Welch [7] as a cause of pulmonary edema—that the right ventricle delivers more blood than the left ventricle can empty, a version accepted by Meltzer [8] as the cause of edema of the lungs produced in the rabbit by epinephrine.

Auer and Gates,[9] however, although confirming Emerson's results as to the alleviation of pulmonary edema by artificial respiration, concluded that the essential mechanism was the lowering of the negative pressure in the chest rather than an effect on the circulation. Since epinephrine produced bronchial constriction in animals, large doses resulted, in the opinion of these authors, in a necessity for high negative pressure within the chest to carry air into the alveoli. However, Emerson made the suggestion that artificial respiration be tried in the treatment of acute pulmonary edema clinically, and a case in which the condition was successfully treated by this method was reported by Barringer [10] in the same year. A still earlier instance of the striking therapeutic value of respiration against positive pressure was reported by Norton [11] in 1897 in a case of phenol poisoning, although the physiologic basis for the action of positive pressure was not part of the article. That breathing against positive pressure tends to reduce secretion in the bronchi and bronchioles by terminating the inflating effect on the mucous membrane was suggested by work reviewed by Oertel.[12]

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6. Emerson, Haven: Artificial Respiration in the Treatment of Edema of the Lungs, Arch. Int. Med. **3**:368 (May) 1909.

7. Welch, W. H.: Zur Pathologie des Lungenodem, Virchows Arch. f. path. Anat. **2**:375, 1878.

8. Meltzer, S. J.: Edema: A Consideration of the Physiologic and Pathologic Factors Concerned in Its Formation, Am. Med. **8**:197, 1904.

9. Auer, J., and Gates, F. L.: Experiments on the Causation and Amelioration of Adrenalin Pulmonary Edema, J. Exper. Med. **26**:201, 1917.

10. Barringer, T. B., Jr.: Pulmonary Edema Treated by Artificial Respiration, Arch. Int. Med. **3**:372 (June) 1909.

11. Norton, N. R.: Forced Respiration in a Case of Carbolic Acid Poisoning, Med. & Surg. Rep. Presbyterian Hosp. **3**:231, 1897.

12. Oertel, M. J.: Respiratory Therapeutics, in von Ziemssen, H.: Handbook of General Therapeutics, translated from the German by J. Burney Yeo, Baltimore, William Wood & Company, 1885, vol. 3, p. 547.

In more recent times, Plesch [13] suggested treatment by respiration against positive pressure, especially in those cases in which the patient's respiration is "rattling," and Poulton [14] has seen beneficial results from its use in cases of paroxysmal dyspnea (cardiac asthma). Woodman [15] treated the seromucous oozing in the tracheobronchial tree that follows tracheotomy by expiration against resistance. We have also tried the procedure of having patients with this condition expire into a tube immersed in a water bottle at a pressure of 5 cm. of water, the pressure being gradually decreased. We have been struck by the prompt benefit of the procedure and the ability to dispense with suction.

Patients with acute pulmonary edema occurring in the course of cardiorespiratory disease have been successfully treated by respiration against positive pressure.[15] The application of positive pressure within the lung exercises an opposing force which tends to prevent further transudation of serum. There is in addition some retardation of the inlet of blood into the right side of the heart.

In summary, it has been shown that respiration against positive pressure lessens the need for a powerful inspiratory effort with its dilating effect on the air cells, its pathologic elevation of the intrathoracic negative pressure, and its suction action on the pulmonary capillaries, which is followed by congestion and edema. The effect of breathing under positive pressure on the circulation is being made the subject of a special study by Barach. It is obvious that the use of large pressures would prevent the entrance of blood into the right heart and result in circulatory failure, as Weber [16] stated in 1851.

The slight to moderate pressure such as is employed clinically has no such influence, but the more precise determination of the effect on the venous pressure, the circulation time and other measurements will be presented in a later communication.

We may now summarize what takes place when an animal breathes against an obstruction in the upper air passages. There is, first of all, an increase in the intrapleural negative pressure, which takes place immediately on application of the obstruction. The pulmonary ventilation is maintained at the same level or at an increased level, but with obvious increased effort. As a result of the continued obstruction and

13. Plesch, J.: Functionelle Gefassdiagnostik: Beziehung zwischen Schlagvolumen und Gefassystem, Ztschr. f. klin. Med. **123**:208, 1933.

14. Poulton, E. P.: Left Sided Heart Failure with Pulmonary Edema Treated with the Pulmonary Plus Pressure Machine, Lancet **2**:981, 1936.

15. Woodman, M.: On the Control of Air Pressure in the Lungs After Tracheotomy, J. Laryng. & Otol. **50**:214, 1935.

16. Weber, Eduard: A Process for Interrupting Voluntarily the Circulation of the Blood and the Function of the Heart, Arch. f. Anat. z. Physiol. u. wissensch. Med., 1851, p. 88; quoted by Oertel,[12] p. 468.

the elevated negative pressure in the chest, blood enters the right chamber of the heart and the lungs more freely but is retarded in its departure from the lungs into the left heart as a result of the backward suction pressure on the left ventricle as it delivers blood into the extrathoracic aorta. The elevated negative pressure within the chest exercises suction on the capillary walls, which is the important factor in the production of intra-alveolar exudate. This factor becomes additionally important as blood accumulates in the lung, building up an increased capillary blood pressure which makes for oozing of serum. As the lungs fill with blood an increasing negative pressure becomes necessary to ventilate them adequately; in this way a vicious circle takes place in which the increased effort to breathe is followed by an increased pathologic state in the lung. It is of considerable importance that these changes result from obstruction to inspiration and not from obstruction to expiration.

It would appear, therefore, that when pulmonary emphysema takes place as the result of obstruction to breathing the cause is not a distending backward pressure on the alveolar wall but rather the increasing distention of the alveoli during inspiration. As the result of obstruction there is incomplete emptying of the air cells during expiration, with the result that the following inspiration further distends the alveolar wall, which is thereby stretched, with impairment of its blood supply and finally rupture of capillary blood vessels and enlargement of the air cell. As the result of the distending pressure, atrophy of the wall has taken place. As has already been remarked, we have observed emphysema in animals without expiratory obstruction, as a result purely of the stretching effect of a pathologically elevated intrapleural negative pressure. Investigations of Prinzmetal [17] have led him to a similar conclusion, namely, that it is as a result of the stretching of the lungs during inspiration that emphysema takes place in conditions of respiratory obstruction rather than as the effect of obstruction during expiration.

With this in mind, employment of any remedy which will lower the pathologically elevated intrathoracic negative pressure not only will facilitate the ventilation of the lungs but will ameliorate the consequences of increased negative pressure, thereby tending to prevent both congestion and edema in the lungs, as well as the conceivable disproportion in the output of the two ventricles and consequent failure of the left heart.

At the onset of respiratory obstruction a sensation of dyspnea takes place in the absence of oxygen want or accumulation of carbon dioxide. This is to be interpreted as an interruption of certain reflex arcs.

17. Prinzmetal, M.: The Relation of Inspiratory Distention of the Lungs to Emphysema, J. Allergy **5**:493, 1934.

The human organism is accustomed to a certain velocity of air flow in and out of the lungs, which appears to be interpreted through the Hering-Breuer reflex. The increased muscular effort necessary to maintain adequate or accustomed pulmonary ventilation gives rise to dyspnea. The inhalation of pure oxygen in this instance does not modify the sensation of shortness of breath, since there is equally as great effort in inhaling an atmosphere of 100 per cent oxygen as there is in inhaling air, there being little difference in the density of the two gases. However, when obstruction is long continued, breathing becomes rapid and shallow, and, in addition, changes in the pulmonary circulation and the alveolar membrane take place which give rise to anoxemia. Under

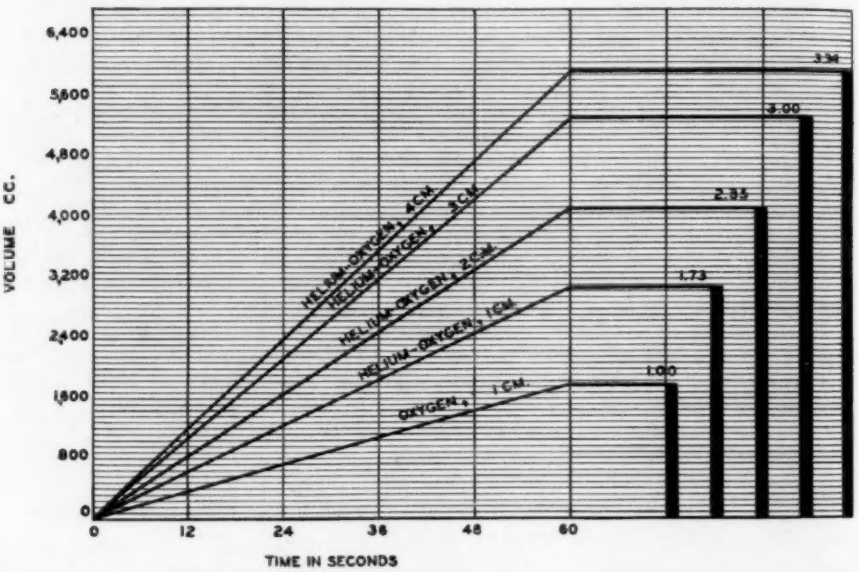

Fig. 3.—Comparison of flow of oxygen with that of a mixture of 83 per cent helium and 17 per cent oxygen under pressure of from 1 to 4 cm. of water through an orifice 2 mm. in diameter.

these circumstances the inhalation of an atmosphere rich in oxygen aids the patient in two ways: (1) by decreasing the pulmonary ventilation and (2) by increasing the functional capacity of the heart muscle. A decrease of the negative pressure within the chest does take place under these circumstances, i. e., when an atmosphere of 100 per cent oxygen is breathed. This decrease in the intrapleural negative pressure is related to the lessened volume of gas inhaled. Since a mixture of helium and oxygen may enter and leave the lungs with even less effort, with a more marked lowering of the intrapleural negative pressure mixtures than of oxygen and nitrogen, this mixture seems more applicable to the patient with obstruction in any part of the pulmonary

airway. The effectiveness of helium is increased, as has been discussed, by administering the gas under a slightly positive pressure.

The increased effectiveness of therapy with helium and oxygen administered with positive pressure may be shown in figure 3. If an atmosphere of 100 per cent oxygen is passed through an orifice 2 mm. in diameter under a pressure of 1 cm. of water, 1,760 cc. of oxygen will be delivered in sixty seconds. Under the same conditions 3,080 cc. of a mixture of helium and oxygen (helium, 83 per cent and oxygen, 17 per cent) will be delivered. However, if the pressure of the mixture of helium and oxygen is increased by an additional 1 cm. of water, 4,160 cc. of the combined gas will pass the narrowed orifice during the same period. The ratio of the flow of oxygen under a pressure of 1 cm. compared to that of the mixture of helium and

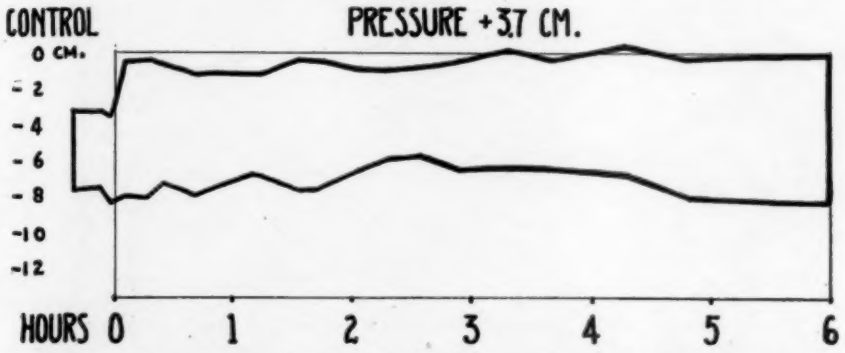

Fig. 4.—Range of the intrapleural pressure in a dog breathing against a positive pressure of 3.7 cm. of water for six hours. The upper graph represents the pressure during expiration, the lower graph that during inspiration. The record shows absence of appreciable increase in the intrapleural pressure at the end of six hours.

oxygen without additional pressure is 1 : 1.73, whereas if the mixture of helium and oxygen is under an additional pressure of 1 cm. the ratio is 1 : 2.55.

On inspection of figure 3 from the point of view of the pressure required to move a given volume of gas it may be seen that the movement of 1,760 cc. of oxygen requires sixty seconds with a pressure of 1 cm., that of the same amount of the mixture of helium and oxygen under the same pressure thirty-four seconds and that of the same amount of the mixture of helium and oxygen under an additional pressure of 1 cm. twenty-five seconds.

With higher pressures increased velocity of flow is obtained, either the delivery of a greater volume of gas at a constant time or a constant volume of gas at a diminished period of exposure to the heightened pressure.

Not only does breathing an atmosphere under increased pressure increase the velocity of flow toward the lungs during inspiration, but this increased ventilation is obtained in the presence of an interpleural pressure which is nearer that of the atmosphere. In figure 4 the range in the intrapleural pressure of a dog breathing against a positive pressure of 3.7 cm. of water for six hours is shown. It will be observed that the negative pressure during expiration rose from approximately 3 cm. of water to atmospheric pressure, whereas the negative pressure of 8 cm. of water during inspiration stayed the same during the course of the experiment. The record shows the absence of any appreciable increase in the negative pressure within the chest at the end of an experiment of

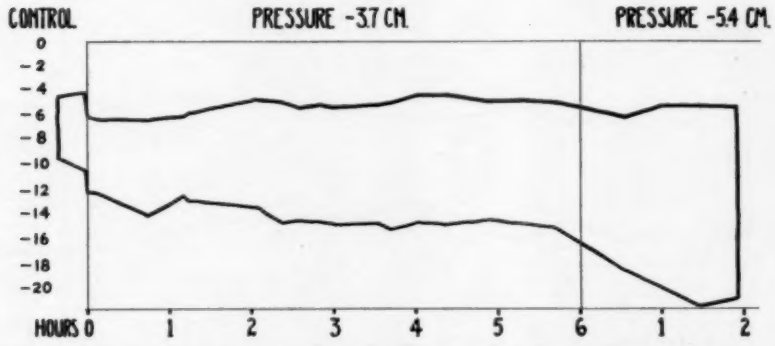

Fig. 5.—Range in the intrapleural pressure of a dog breathing against a negative pressure of 3.7 cm. of water for six hours and against a negative pressure of 5.4 cm. of water for two additional hours. The upper graph represents the pressure during expiration, the lower graph that during inspiration. The record indicates progressive increase in the negative pressure within the chest.

six hours. In figure 5 is shown the range in the intrapleural pressure of a dog breathing against a negative pressure of 3.7 cm. of water for six hours and against a negative pressure of 5.4 cm. of water for two additional hours. In this case there was a progressive increase in the negative pressure in the intrapleural cavity, which was especially marked during inspiration. The total difference between the pressure on inspiration and that on expiration was markedly increased. These diagrams are inserted to show the different effects on the mechanics of respiration between breathing under a positive pressure and breathing under a negative pressure.

In clinical experience the mixture of helium and oxygen is generally administered at a positive pressure of between 2 and 4 cm. of water. This degree of increase in pressure decreases the inspiratory effort without unduly limiting the entrance of blood into the right heart. The concentration of oxygen employed is between 21 and 35 per cent.

depending on the degree of anoxemia which the patient presents. A concentration of 25 per cent oxygen, the remainder of the atmosphere being helium, tends to counteract the anoxemia frequently present and at the same time, by maintaining a high concentration of helium, overcomes the respiratory fatigue by decreasing the muscular effort necessary for breathing.

We wish now to report the clinical results in twenty-one patients with obstruction in some part of the pulmonary airway who were treated by the inhalation of a mixture of helium and oxygen and to discuss the interrelation between inhalation therapy and surgical procedures.

METHODS

The inhalation of a mixture of helium and oxygen has been described elsewhere.[1f] In adults a mask or a mouthpiece apparatus may be used for short

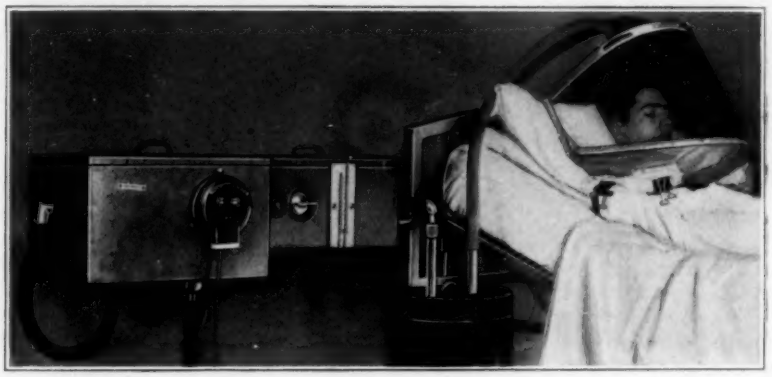

Fig. 6.—Helium and oxygen hood tent.

periods. For longer periods a hood modeled on the Benedict helmet type of apparatus[18] enclosing the head and making contact at the neck seems more desirable. In infants and children we first employed a body tent which had been made especially leak tight to helium, but later the helmet hood type of apparatus which makes closure at the neck seemed preferable, especially since positive pressure could be employed with it. We now use a mixture of helium and oxygen in one tank and modify the concentration of oxygen by running in oxygen from a separate tank. It is of special importance to test the concentration of oxygen within the tent and the amount of oxygen admitted in order that excessive amounts of helium may not be inadvertently administered to the point of asphyxia. With the use of mixture of a helium and oxygen in one tank there is less likelihood of error than when the two gases are admitted from two separate tanks.

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18. Benedict, F. G.: Der Helm-Respirationapparat in seinen verschiedenen Formen, in Abderhalden, E.: Handbuch der biologischen Arbeitsmethoden, Berlin, Urban & Schwarzenberg, 1933, vol. 4, pt. 13, pp. 465-524.

REPORT OF CASES

CASE 1.—*History.*—The patient was a man aged 52 years. The family history and the past history were irrelevant. For four months the patient had complained of hoarseness, inability to talk and painful swallowing, and for two months of obstruction to breathing. Increasing dyspnea developed in the twelve hours previous to admission.

Physical Examination.—This showed the patient to be a poorly developed man of 52. The larynx showed irregular raised granulations blocking the passageway; the vocal cords were involved and moved only slightly on phonation. Examination of the lungs revealed distant breath sounds, wheezing râles over the upper lobe of each lung and crepitant râles in the axillae.

Treatment and Course.—Difficulty in breathing became progressively worse and respiration was obviously obstructive in character. The rebreathing apparatus was used, with a mask strapped to the face. The patient inhaled an atmosphere of 20 per cent oxygen and 80 per cent helium under a positive pressure of from 0.5 to 1 cm., with marked relief. After two hours his condition was much improved, only slight obstructive respiration being manifest. Two days later, tracheotomy was done to avoid subsequent episodes of acute dyspnea. The diagnosis was squamous cell epithelioma of the larynx.

CASE 2.—*History.*—The patient was a boy aged 3½ years. The family history and the past history were noncontributory. Four days after a cold, cough and difficulty in breathing developed.

Physical Examination.—This showed the patient to be a well nourished white child breathing with difficulty and considerable retraction of the substernal space. Examination of the lungs showed rough inspiration with a whistling quality to expiration. The diagnosis was croup.

Treatment and Course.—The patient was placed in a tent containing an atmosphere of 25 per cent oxygen and 70 per cent helium, with considerable relief of the dyspnea. There was no cyanosis. After twelve hours the patient was removed from the tent improved, although inspiration still required an obvious effort. He continued to recover, and left the hospital four days later.

This child might have recovered without the use of intubation, tracheotomy or even the helium and oxygen tent. He was of an age sufficient to make him resistant to exhaustion, and the obstruction was not sufficient to cause cyanosis. So the chief benefit of the helium and oxygen was the relief of the suffering which accompanied the obstruction. With this therapy rest and sleep became possible, and after twelve hours in a tent the child could carry on without further help.

CASE 3.—*History.*—After sore throat one week before admission, a youth aged 19 years became hoarse and found breathing increasingly difficult.

Physical Examination.—On examination of the larynx, the ventricular bands and the epiglottis were seen to be swollen and inflamed.

Treatment and Course.—The patient was put in the helium and oxygen tent, the concentration of oxygen being 23 per cent and that of helium 70 per cent. The dyspnea was relieved, and twelve hours later the larynx had become much less swollen. The tent was removed, and the patient was discharged well two weeks later.

This patient belongs in the same classification as the patient in case 2. The symptom calling for relief was the distress due to the dyspnea. He was of an age at which inflammation of the larynx is not ordinarily accompanied by danger. Nevertheless, the distress was severe, and the helium and oxygen treatment completely relieved it.

CASE 4.—*History.*—The patient was a girl aged 11 months. The past history was irrelevant. The mother noticed that the patient breathed with difficulty for three days. Two days before admission retraction of the chest with each respiration was observed.

Physical Examination.—The patient was seen to be a well nourished colored girl infant, extremely irritable, with a croupy cough and crying, with mild retraction of the chest above and below the sternum. The lungs were clear. On the day of admission the child became much worse, with marked retraction of the chest below the lower end of the sternum. Ipecac was given, without relief.

Treatment and Course.—The child was placed in a tent containing an atmosphere of 25 per cent oxygen and 70 per cent helium. She struggled when first placed in the tent but soon dropped off in a sound sleep, with slower and apparently unobstructed breathing. On the following day breathing was still improved but croupy inspirations were audible. Examination of the larynx showed reddened, thickened, slightly edematous vocal cords. That night the patient was removed from the tent, and inhalation of steam was tried, without much relief. She was placed in the tent at 3 a. m., and the following day was improved. She breathed slowly and deeply, with some stridor still present. She slept peacefully. Motion pictures were obtained outside the tent and inside; these revealed definite decrease in retraction of the subcostal region with administration of an atmosphere of 30 per cent oxygen and 65 per cent helium. On the following day respirations were still rather noisy, but there was little retraction of the chest, and the patient was removed from the tent. However, an intermittent fever continued, and the cough persisted. A laryngoscopic examination was made, but no foreign body could be seen. There was subglottic edema. Shortly after this procedure extreme respiratory obstruction with marked retraction of the chest below the sternum developed. The patient was again placed in a mixture of 25 per cent oxygen and 70 per cent helium and slowly improved. She was fairly comfortable but showed still considerable retraction of the chest. Eight hours later she began to get worse again and showed marked retraction of the chest, and tracheotomy was done. This was followed by abrupt development of bilateral pneumothorax; with the fluoroscope it was seen that the upper and middle lobes of the right lung showed collapse; there was also complete collapse of the left lung. She was then placed in a tent containing an atmosphere of 60 per cent oxygen. Bilateral otitis media subsequently developed, necessitating myringotomy on the left and simple mastoidectomy on each side. She was discharged improved two months after the tracheotomy was performed.

The patient was at first treated for laryngismus stridulus. During treatment with an atmosphere of helium and oxygen the dyspnea was largely controlled, and in four days the condition had materially subsided. However, after the second laryngoscopy, laryngeal edema took place, which was only temporarily relieved by inhalation of an atmosphere of helium and oxygen, so that tracheotomy became finally necessary.

This case illustrates three things. In the first place, there was initial definite relief of the dyspnea by the helium and oxygen. In the second place, the necessity of avoiding as far as possible any operative intervention in the larynx, even a short direct examination, which may increase swelling is brought out. There is obviously a limit to the amount of obstruction which the helium and oxygen may relieve, and an attempt should be made to keep within this limit. In the third place, it is seen that tracheotomy is rendered a much safer procedure when the patient has been in the mixture of helium and oxygen for a few hours and has had some relief from the exhaustion due to the preceding dyspnea.

Case 5.—*History.*—The patient was a boy aged 1 year. The family history was noncontributory. Four days before admission cough and a temperature of 104 F. developed. On examination the local physician found the child to have tonsillitis. Two days before admission breathing became rapid and labored, and the day before admission retraction of the subcostal region became evident.

Physical Examination.—The patient was seen to be a pale, toxic, acutely ill baby. Respirations were over 60 per minute and were accompanied by a frequent harsh croup cough. Retraction of the chest along the line of the diaphragmatic attachments anteriorly was observed. There was slight cyanosis. The tonsils were enlarged markedly, and there was edema of the mucous membranes of the pharynx and epiglottis. The lungs were clear. The diagnosis was acute pharyngitis and tonsillitis and acute laryngotracheitis.

Treatment and Course.—The patient was placed in a tent containing an atmosphere of 25 per cent oxygen and 70 per cent helium, with considerable relief of the dyspnea. Twenty-four hours later the retraction of the chest had disappeared, and the tent was removed. The patient steadily improved, and was discharged clinically cured after five days. Culture of material from the nose and the throat showed pneumococci predominating, with a few staphylococci, Staphylococcus aureus-haemolyticus and occasional hemolytic streptococci.

This case belongs in the class of cases in which the patient requires relief from dyspnea for a relatively short period to tide him over the most acute part of his illness.

Case 6.—*History.*—The patient was a girl aged 9 years. The family history was noncontributory. After tonsillectomy twelve days prior to admission, pain in the chest, cough, blood-tinged sputum and increasing dyspnea developed. A roentgenogram showed a tooth in the left lung. Bronchoscopy was twice attempted unsuccessfully at an out-of-town hospital, and the patient was transferred to the Babies Hospital, New York.

Physical Examination.—This showed an acutely ill white girl of 9 years sitting propped up in bed: dyspnea, orthopneia, foul sputum and breath and slight cyanosis were noted. Over the left side of the chest there was hyperresonance, with amphoric breath sounds over the upper lobe of the left lung and skodaic resonance merging into dulness and flatness at the base. Breath sounds were absent at the base.

Treatment and Course.—Bronchoscopy was performed, with removal of the tooth, but fever, cough and toxemia continued. Two weeks later bronchoscopy was done a second time with the object of aspirating purulent material from the

left main bronchus. Nine days later severe obstructive dyspnea with marked retraction of the suprasternal and subcostal spaces developed. The patient was put in a tent containing an atmosphere of 25 per cent oxygen and 70 per cent helium, with considerable relief. After two days she was taken out of the helium and oxygen tent. Obstructive dyspnea was decreased, although it was still present, and on the following day tracheotomy was performed. Five weeks later the tracheotomy tube was removed. The patient was discharged much improved.

This case is of unusual interest because the condition followed bronchoscopic removal of a foreign body. In some of the cases in which obstructed respiration is due to a foreign body the presence of the tube in the larynx for a number of minutes is called for. This use of the tube is always accompanied by the danger of subglottic edema. In this case tracheotomy was done because the dyspnea threatened to last for some time and prolonged use of helium and oxygen was impractical.

CASE 7.—*History.*—The patient was a boy aged 1 year. The family history was noncontributory. Four days previous to admission a cough and slight fever developed. One day before admission difficult breathing with stridor occurred.

Physical Examination.—This showed a well nourished white infant with inspiratory stridor and crowing respiration and moderate retraction of the suprasternal and subcostal spaces. On examination of the lungs occasional rhonchi were heard. Fluoroscopy showed no evidence of a foreign body. The diagnosis was acute laryngitis associated with edema.

Treatment and Course.—The chest became filled with coarse and squeaking râles. Indirect laryngoscopic examination revealed marked inflammation and swelling of the epiglottis. The patient was put in a tent. An atmosphere of 90 per cent oxygen was first administered, which appeared to lessen the respiratory rate, but the retraction of the chest was not relieved until an atmosphere of 70 per cent helium and 25 per cent oxygen was administered, when signs of obstructive dyspnea almost completely receded. The patient was kept in the helium and oxygen tent for two days, when he was removed, without reappearance of the dyspnea and stridor. A note by the consultant in diseases of the nose and throat said that the patient would undoubtedly have required tracheotomy in the absence of helium and oxygen therapy. Four days after the removal of the tent the patient was discharged clinically cured.

This case calls for no extended comment. There was self-limited inflammation of the larynx, which was sufficiently relieved by inhalation of helium and oxygen so as not to require surgical intervention.

CASE 8.—*History.*—The patient was a girl aged 16 months. The family history was noncontributory. Six days prior to admission the patient inhaled a pea. She coughed violently for twenty minutes, and then only a wheezing sound was heard during respiration. Three days before admission she had undergone unsuccessful bronchoscopy, after which there was marked respiratory distress.

Physical Examination.—This revealed a well nourished female infant of 16 months acutely ill with laryngeal stridor. The breath sound was diminished over the lower lobe of the left lung. There were no râles.

Treatment and Course.—By means of bronchoscopy removal of a small foreign body from the lower part of the left main bronchus was accomplished, after which

breathing became increasingly difficult, with development of marked retraction of the suprasternal and subcostal spaces. The patient was put in a tent containing an atmosphere of 25 per cent oxygen and 70 per cent helium, with immediate relief. Breathing became quiet. There was no retraction of the chest, and the child slept quietly. On the following morning respiration again became difficult, with reappearance of retraction of the chest. Tracheotomy was performed, as it was believed that laryngeal edema had increased. Two weeks later the tracheotomy wound was practically healed, and the patient was discharged clinically cured.

This is another case of obstructed respiration due to a foreign body in a young child. It is the peculiarity of such conditions that the edema is likely to be greater in the second twenty-four hours than in the first. The benefits of helium and oxygen were marked in this case, as the child was relieved of the dyspnea and exhaustion which followed both bronchoscopies. After twenty-four hours the amount of obstruction approached the limit which helium and oxygen could remove. It was then thought best to perform tracheotomy. Relief from dyspnea had been such that tracheotomy was safely performed on a patient in good condition, not one exhausted by dyspnea.

Case 9.—*History.*—A girl aged 8 months had been feverish for six days. For four days sore throat and dyspnea had been present. During the twenty-four hours preceding admission the dyspnea became more marked. A retropharyngeal abscess was opened with the finger. The temperature was 107 F. The patient was very ill. Contraction of the suprasternal and intrasternal spaces were evident.

Treatment and Course.—The infant was placed in a Benedict helmet apparatus containing an atmosphere of 22 per cent oxygen and 74 per cent helium. She showed a definite although slight improvement in the dyspnea, with, however, a marked decrease in restlessness. Her symptoms steadily improved, and she was removed two days later without recurrence of the dyspnea.

This was an excellent result in an extremely sick young infant. The mortality of retropharyngeal abscess in such infants is high, even after drainage of the abscess. The relief of the restlessness and consequent relief from danger from exhaustion tided the infant over the time required for the subsidence of the parapharyngeal swelling.

Case 10.—*History.*—This patient, a girl aged 6 weeks, has been previously reported on.[1b] The patient suffered from stridor since birth. Three days before admission her condition became worse, and she choked on eating. During her examination in the outpatient department she had an acute respiratory collapse and was admitted as an emergency patient.

Physical Examination.—She was seen to be a well developed infant, gasping at each breath. On inspiration there was marked retraction of the suprasternal, intercostal, subxiphoid and subcostal spaces. She became markedly cyanotic on crying. The lungs were clear.

Treatment and Course.—The administration of an atmosphere of from 90 to 100 per cent oxygen in the helium and oxygen tent removed most of the cyanosis but did not relieve the dyspnea. When an atmosphere of 68 per cent helium and 24 per cent oxygen was given the dypsnea was much relieved. The retraction of

the muscles of the neck disappeared, but slight retraction of the subxiphoid region was evident. Undoubtedly, even better results would have been secured if pure helium had then been available. As it was, the patient's respiration declined to 20 per minute in the tent atmosphere of helium and oxygen; she slept peacefully and could take her nourishment without effort. When she was taken out of the tent the respiratory rate accelerated to 40 per minute; marked retraction of all the accessory muscles of respiration became manifest, and she became restless and unable to take her feedings. She was kept in the atmosphere of helium and oxygen for eight days in the hope that the obstructive process might clear. No improvement in her condition when outside the tent took place, and tracheotomy was performed. The obstruction was found to be just above the bifurcation; its nature was not discovered. After tracheotomy bilateral pneumothorax with urgent dyspnea developed. This was relieved only when the concentration of oxygen was kept above 90 per cent. At the end of sixteen hours it was reduced to 50 per cent, and in three days the use of oxygen was discontinued. The baby was well one month after tracheotomy, except that repeated aspirations of the trachea were necessary. Three months later she died suddenly. At autopsy the tracheotomy tube was observed to have eroded a soft tumor in the tracheal wall and ruptured the innominate artery.

This case is of unusual interest. The child was almost completely relieved from her dyspnea, and probably she could have been carried on indefinitely in the helium and oxygen tent. Moreover, it was possible to do a bronchoscopy and ascertain the etiology of the destruction, a tracheal tumor, without causing any distressing laryngeal obstruction. In this case also, however, the element of time was a consideration. It was not possible to use helium and oxygen indefinitely, and after eight days this treatment was discontinued.

Case 11.—*History.*—This patient, a boy aged 4 months, has been previously reported on.[1b] The patient had had a cold in the head with a cough for six weeks, when suddenly his breathing became difficult and wheezy. His subsequent history revealed that he swallowed "something green" at 9 a. m.

Physical Examination.—On examination late that afternoon, he was seen to be a fairly well developed boy of 4 months. His respirations were accompanied by a sound which seemed to be produced near the larynx. The lungs were normal except for occasional wheezing sounds. Roentgen examination showed a speck in the infraglottic region. Laryngoscopy was done, followed by esophagoscopy, with removal of a green tack from the esophagus. On the following evening he became markedly dyspneic, with retraction of the muscles of the neck, cyanosis and restlessness.

Treatment and Course.—The administration of an atmosphere of 90 per cent oxygen in a tent cleared the cyanosis but gave no relief from the dyspnea. Helium was then added to a concentration of 80 per cent, the concentration of oxygen being 20 per cent. The boy became obviously more comfortable within a few minutes, with relief of the dyspnea but with perceptible cyanosis. The concentration of oxygen was then increased to 30 per cent, that of helium being 70 per cent. The patient's color then became pink, and dyspnea was absent. He was given codeine. At 6 a. m. the following day he was fed and changed outside the tent. Marked difficulty in breathing and restlessness returned. After about six to eight coughing spells, between each one of which he had a free interval, tracheotomy

was done, at 3 p. m. The patient was then comfortable for a time, when severe dyspnea again developed. During the following five days bronchoscopy or aspiration had to be repeatedly carried out to remove mucus plugging the bronchi. Bronchopneumonia developed during this period, and the patient died six days after tracheotomy. At autopsy diffuse bronchopneumonia was observed but no laryngeal obstruction or edema.

This is another case of obstructed respiration due to a foreign body in a young infant, the foreign body being a tack in the upper part of its esophagus. In the passage of the foreign body downward in the esophagus the larynx had been injured in the region of the arytenoids. Helium and oxygen relieved the dyspnea and cyanosis when the child was breathing quietly. Attacks of coughing, however, with succeeding cyanosis and dyspnea, aroused the fear of sudden death. Consequently tracheotomy was done, which was followed by bronchopneumonia, from which the child died.

Case 12.—*History.*—The patient was a boy aged 11 years. The family history and the past history were irrelevant. After evidence of sarcoma of the left leg, removal of the left hip joint was performed, four months previous to admission. Rapidly increasing dyspnea due to metastatic extension to the lungs and mediastinum, with pleural effusion, brought the patient to the hospital.

Physical Examination.—This showed a boy in severe respiratory distress, gasping for each breath, with marked retraction of the suprasternal and infrasternal spaces, pale and cyanotic and very restless. Morphine had to be administered frequently. The temperature was 101 F. The pulse rate was 160, and the respiratory rate 40.

Treatment and Course.—The patient was put in a tent containing an atmosphere of from 22 to 25 per cent oxygen and 65 per cent helium, with marked improvement in the dyspnea and restlessness. The cyanosis diminished, and the respiratory rate slowed to 24, even with marked lessening of the doses of morphine. At first the patient was apprehensive of the tent but later did not wish to be removed. After a day and a half of relative improvement the signs of obstructive dyspnea increased, and the patient died. In this case the source of obstruction was too low to permit benefit from any surgical procedure.

This case shows the limits of helium and oxygen therapy. Only a certain amount of obstruction can be relieved. If the obstruction advances beyond that amount, other means of relieving it must be adopted. In this case, of course, in which there was a rapidly growing new growth, no therapeutic measures could have been successful.

Case 13.—*History.*—The patient was a girl aged 23 months. The family history and the past history were noncontributory. Seven days before admission cough and fever developed. Two days before admission an abscess of the left ear opened spontaneously, and she became short of breath.

Physical Examination.—This showed the patient to be a fairly well nourished girl infant who appeared acutely ill. The temperature was 103.6 F. The pulse rate was 168 and the respiratory rate 68. Breathing was rapid and extremely labored; the skin was gray, and there was marked cyanosis of the lips and nailbeds, with retraction of the suprasternal and intercostal regions. Examination of the lungs showed breath sounds characterized by prolonged wheezing, accompanied throughout by fine, medium and coarse râles.

Treatment and Course.—The patient was put in an oxygen tent the concentration of oxygen being 50 per cent for four days, with improvement in the cyanosis but not in the dyspnea. After four days she was transferred to a tent containing an atmosphere of 65 per cent helium and 30 per cent oxygen, without relief of the dyspnea. The mixture was then changed to 21 per cent oxygen and 75 per cent helium, after which she immediately became better. The cyanosis disappeared; breathing became easier, and there was marked lessening of the retraction of the subcostal and suprasternal regions. For the following six days the patient continued to be extremely ill, the temperature ranging between 105 F. and normal. Whenever the child was taken from the tent she became very cyanotic, and respirations became labored. The patient died. The diagnosis was bilateral bronchopneumonia (due to a hemolytic streptococcus and Bacillus influenzae), acute suppurative bilateral otitis media (due to a hemolytic streptoccus) and bacteremia (due to a hemolytic streptococcus).

In this case the child was completely relieved of the dyspnea and restlessness. The relief, of course, could influence the course of the sepsis only indirectly, and the child died of sepsis.

Case 14.—*History.*—The patient was a woman aged 75 years. The family history and the past history were irrelevant. This patient had intrathoracic carcinoma of the thyroid gland, which had been diagnosed one month previously, for which she had been receiving treatment for two weeks. During the twenty-four hours preceding admission increasing difficulty in breathing, stridor and cyanosis developed.

Physical Examination.—This showed a stout elderly woman with manifest obstructive dyspnea and loud stridor. There were many moist râles at the base of the lungs. Examination of the larynx showed marked edema of the left false vocal cord and moderate edema of the right false vocal cord.

Treatment and Course.—The patient was kept in a tent containing an atmosphere of 30 per cent oxygen and 70 per cent helium, with marked relief of the dyspnea and stridor. At the end of four days a shortage in the supply of helium necessitated removal to an oxygen tent. The patient became steadily more dyspneic and died the same day. Intubation, as well as an emergency tracheotomy, was performed, without relief.

This case was that of an aged woman ill with incurable carcinoma. In spite of the serious nature of the illness, the dyspnea and stridor were relieved. If the supply of helium had not failed, she might have lived indefinitely. The intubation and tracheotomy tubes did not reach below the point of obstruction in her trachea; consequently their introduction did not relieve the obstructive dyspnea. This is a point to be remembered in helium and oxygen therapy. It may relieve obstructions situated in a region which intubation and tracheotomy cannot reach.

Case 15.—*History.*—The patient, a boy aged 2½ months, was a twin born prematurely at 7 months. Since discharge from the obstetric ward, three weeks before admission, the infant had had twitchings and contortions of the face; he was admitted for observation.

Physical Examination.—This showed a typical premature infant with a tight cough; the eyes were puffy, and there were fine moist râles throughout the chest.

Three days later, signs of bronchopneumonia developed, and the patient became extremely toxic and cyanotic. This was followed on the next day by marked retraction of the suprasternal and subxiphoid regions.

Treatment and Course.—The patient was put in a tent containing an atmosphere of 30 per cent oxygen and 65 per cent helium and at first seemed to breathe easier. However, after three hours the temperature dropped to 95.4 F. The patient was removed from the tent and showed marked abdominal distention. No relief was obtained by a rectal tube, and an attempt was made to wash out the stomach, but the infant stopped breathing during the process. The diagnosis was bilateral bronchopneumonia, active, severe rickets and prematurity.

This child was partially relieved by gas therapy but died outside of the tent. This suggests that in cases in which a young infant has been suffering from dyspnea for a number of days and is approaching the point of exhaustion it should be left in the mixture of helium and oxygen long enough for it to recover from the effects of exhaustion before any therapeutic procedure in the throat is attempted. This point has already been emphasized in connection with tracheotomy.

CASE 16.—*History.*—The patient was a woman aged 56 years. The family history was noncontributory. The patient was known to have had a toxic nodular goiter with hypertension for five years; nervousness, palpitation and weakness were the main symptoms.

Physical Examination.—This showed a very nervous, emotionally unstable woman of 56. The heart sounds were poor in quality and rapid, and there was a short harsh systolic murmur at the apex of the heart. The blood pressure was 200 systolic and 100 diastolic. There was a fine tremor of the hands.

Laboratory Findings: The basal metabolic rate was plus 40. An electrocardiogram showed the T_2 wave to be of low amplitude and the T_3 wave to be inverted, suggesting myocardial damage. After treatment with compound solution of iodine U. S. P. the basal metabolic rate dropped to plus 27.

Treatment and Course.—After operation the patient became restless and apprehensive. On the following day the temperature rose to 105 F.; the pulse rate was 160 and the respiratory rate 68. Breathing was markedly difficult, with retraction of the suprasternal space. The venous pressure was 280. Edema in the lungs appeared, with coarse râles throughout and audible gurgling respiration in the throat; death seemed imminent. An atmosphere of 50 per cent oxygen and 50 per cent helium was inhaled through a mouthpiece under a pressure of 7 cm. of water. Within ten minutes the signs of pulmonary edema had disappeared; the lungs were completely clear, and the dyspnea was relieved and the cyanosis greatly lessened. The blood pressure was 160 systolic and 100 diastolic and the venous pressure 110 after five hours. The pulse rate declined from 160 at the onset of treatment to 120. The patient continued to maintain improvement for twelve hours, when the venous pressure rose to 245. Twelve hours afterward the pulse rate had risen to 170, the respiratory rate to 60 and the temperature to 107.4 F., and the patient stopped breathing. At the time of her death the lungs were clear anteriorly.

In this case the obstructive factor in the patient's dyspnea was probably due to widespread edema in the tracheobronchial tree. The clearance of the pulmonary edema was due to the application of posi-

tive pressure. The relief of the dyspnea must be attributed more to the application of positive pressure than to the use of helium. The improvement for a period of twelve hours after initiation of treatment was dramatic. Her death was the result of a postoperative thyroid crisis.

CASE 17.—*History.*—The patient was a woman aged 42 years. The family history was irrelevant. For the past nine weeks the patient had complained of having attacks of asthma. For the previous twenty-four hours she had a constant attack and for two hours had been almost unconscious.

Physical Examination.—This revealed an acutely ill, almost moribund woman. Breathing had a very slow rate, with marked stridor, and the patient was cyanotic. To the left of the sternum there was a large pulsating mass, obviously an aneurysm. The heart sounds were clear and loud.

Treatment and Course.—The patient was given an atmosphere of 21 per cent oxygen and 79 per cent helium through a mouthpiece, with evident relief of the dyspnea. There was immediate recurrence of the stridor when the mixture of helium and oxygen was removed. Because of the hopeless nature of the condition, helium and oxygen therapy was stopped. The patient grew worse and died the same day from tracheal compression. At autopsy a huge aneurysm on the ascending portion of the aortic arch and two smaller aneurysms on the descending portion of the aortic arch were observed, with marked compression of the trachea.

This case hardly calls for comment. The dyspnea and stridor seemingly could have been controlled for a much longer period. Intubation and tracheotomy were out of the question on account of the low position of the obstruction in the trachea.

CASE 18.—*History.*—A boy aged 3½ years had leukemia with terminal necrosis and edema of the epiglottis and uvula.

Treatment and Course.—The patient was placed in a tent containing an atmosphere of 21 per cent oxygen and 75 per cent helium, with from slight to moderate relief of exceedingly severe obstructive dyspnea. The temperature was 106.6 F., the pulse rate 172 and the respiratory rate 54. After fifteen minutes in the tent he was removed in the attempt to feed him and abruptly died.

This case emphasizes the point already made—that manipulation of patients approaching exhaustion from obstructive dyspnea is dangerous. The mixture of gas should be used in sufficient time to relieve exhaustion; then the manipulation can safely be carried out, whether it be feeding, general nursing care, laryngeal examination or tracheotomy.

CASE 19.—*History.*—The patient was a girl aged 4 months. The family history was irrelevant. Three weeks before admission the patient became ill with paroxysmal cough followed by vomiting.

Physical Examination.—The patient was seen to be an acutely and seriously ill marasmic infant with frequent severe cough, marked dehydration and retraction over the costal attachments to the diaphragm. The thoracic cage appeared emphysematous, and there was diminished resonance over the upper lobe of each lung. The breath sounds were also diminished, and crackling, fine râles were present over the whole chest.

Treatment and Course.—Twelve hours after admission there was considerable increase in respiratory embarrassment. Marked cyanosis with expiratory difficulty developed, which was unrelieved by epinephrine. Cyanosis was lessened and breathing somewhat relieved by inhalation of an atmosphere of 50 per cent oxygen. Preparations to construct a croup tent were started, but retraction of the chest became more marked. The patient was put in a helium and oxygen tent, which relieved to a moderate extent the retraction in the intercostal spaces and in the subxiphoid region. The cyanosis was relieved by inhalation of an atmosphere of helium and oxygen, the concentration of oxygen being 28 per cent, the remainder of the gas being helium. However, the general condition became worse and the retraction of the chest and the cyanosis ultimately more marked, in spite of the use of the atmosphere of helium and oxygen. Tracheotomy was done as a method of last resort. The patient died three days after admission. At autopsy, purulent laryngitis, tracheitis and bronchitis were observed, with bilateral lobular pneumonia and emphysema of the lungs.

In this case the obstruction was evidently advancing, and it reached a point at which helium and oxygen could no longer give relief. Consequently tracheotomy was done. It should be noted that tracheotomy was safely done and that the patient died of pneumonia, not of strangulation. In young infants suffering severely from dyspnea and exhaustion even the slightest manipulation in the throat may cause sudden death, not necessarily from strangulation but from heart failure. The only quick relief for obstructive dyspnea that compares in efficiency with helium and oxygen is the passage of a bronchoscope through the larynx as a preliminary to tracheotomy. Even this, quickly and efficiently done though it may be, may result in sudden death. Helium and oxygen therapy is, therefore, preferable up to the limit of its efficiency.

Case 20.—*History.*—The patient was a girl aged 5½ years. The family history was noncontributory. The past history revealed pertussis and frequent sore throat. The patient had for one week prior to admission sore throat, hoarseness, high-pitched cough and slight fever. For the two days before admission difficulty in breathing had become progressively worse.

Physical Examination.—This showed a fairly well nourished colored girl of 5½ years, acutely ill and breathing with marked difficulty; laryngeal stridor was present. The pharynx was red, but there was no membrane. Examination of the lungs revealed marked retraction of the suprasternal and subcostal regions with inspiration. The inspiratory and the expiratory phases were equal in length. There was slight hyperresonance throughout the chest, and numerous sibilant râles and wheezes were noted. The cough was of the stridulous type. The diagnosis was laryngeal diphtheria.

Treatment and Course.—Diphtheria antitoxin, 23,000 units in all, was given. After twenty-four hours in the hospital the patient was put in a tent containing an atmosphere of 25 per cent oxygen and 65 per cent helium. The pulse rate at that time was 146, the respiratory rate 46 and the temperature 99.6 F. The patient was kept overnight for twelve hours in the tent, with little relief, and the following day she was definitely no better. A culture was found to be positive for diphtheria organisms, and the patient was transferred to a hospital for persons with infectious disease.

This patient evidently was beyond the point where helium and oxygen could relieve the dyspnea. In such a case as this other means of relieving the dyspnea are called for.

CASE 21.—*History.*—Approximately six months after the excision of a tumor of the salivary gland two years prior to the present admission of a woman aged 79 years, she showed metastatic masses in the abdomen and neck. Roentgen therapy resulted in their disappearance until one month before admission to an outside hospital, when, in addition, there was evidence of metastatic involvement of the mediastinal glands. A roentgenogram of the chest showed the trachea markedly bent on itself. Increasing stridor and dyspnea developed, especially during the two days prior to treatment. When seen by one of us the patient showed marked retraction of the intercostal, supraclavicular and substernal spaces. The stridor was loud. There was a cyanotic hue to the finger-tips. The patient was obviously approaching the point of exhaustion.

Treatment and Course.—The helmet respiration apparatus was first used with pressure of from 2 to 3 cm., 23 per cent of the atmosphere being oxygen and the remainder helium. The relief of the dyspnea and stridor was marked and came on almost immediately. Within thirty-six hours a larger hood without pressure was used. During this period roentgen therapy was continued. The patient gradually improved and in two weeks was able to dispense with helium and oxygen therapy, breathing comfortably in air.

In this case a patient in whom the outcome would otherwise have been fatal was made comfortable until roentgen therapy accomplished decrease in the size of the metastatic masses. (The tumor was either a very cellular carcinoma or a lymphosarcoma.) That an ultimately fatal recurrence of the disease will take place need not be argued, but death through strangulation was avoided, and the patient was restored to a cheerful state of mind, able to perform the occupations to which she was accustomed.

COMMENT

Of twenty-one patients, eleven received marked relief from the signs of obstructed dyspnea. Seven of these patients (1, 2, 3, 5, 7, 9 and 21) were removed from the atmosphere of helium and oxygen without the need for tracheotomy, although one of them had tracheotomy as a precautionary measure two days later (patient 1). All of them recovered. Among the remaining four patients of this group who experienced marked relief as a result of the helium and oxygen therapy there was ultimately a fatal outcome, as a result of tumor in two, due to a thyroid crisis in one and due to bronchopneumonia following removal of attack and subsequent tracheotomy in one.

In three patients little or no relief was evident, one patient being a marasmic infant with bilateral bronchopneumonia (patient 19), the second one having severe laryngeal diphtheria (patient 20; this patient was transferred to a hospital for persons with infectious disease) and the third being a boy with leukemia who had showed marked sloughing of the epiglottis and the uvula (patient 18).

Clinical Data for Twenty-One Patients with Obstruction of the Respiratory Tract Treated by Inhalation of Helium with Oxygen

Case Age, Sex	Clinical State Before Treatment	Administration of Helium and Oxygen: Method	Administration of Helium and Oxygen: Duration of Treatment	Clinical Results	Outcome
1 52 yr. M	Inability to talk, hoarseness and painful swallowing for 4 months, with obstruction to breathing for 2 months, due to carcinoma of larynx; increasing dyspnea 12 hours previous to admission	Mask rebreathing apparatus; 20% oxygen and 80% helium, with 0.5 cm. pressure	2 hr.	Dyspnea relieved; after 2 hours respiration less strained; tracheotomy 2 days later as a precautionary measure	Recovery
2 3½ yr. M	Preceded by a cold, cough and increasing obstructive dyspnea took place; signs of retraction of chest evident; inspiration rough, expiration whistling; diagnosis, croup	Helium and oxygen tent; 25% oxygen, 70% helium	12 hr.	Gradual improvement in dyspnea and removal from tent 12 hours later, with slight residual effort in breathing	Recovery
3 19 yr. M	After sore throat, hoarseness and difficulty in breathing occurred; ventricular bands and epiglottis swollen and inflamed	Helium and oxygen tent; 23% oxygen, 70% helium	12 hr.	Dyspnea relieved by inhalation of mixture of helium and oxygen; 12 hours later larynx had become less swollen; tent removed, and patient discharged well 2 weeks later	Recovery
4 11 mo. F	For 2 days patient suffered from increasing croupy cough and dyspnea with signs of retraction above and below the sternum; laryngeal examination showed thickened, edematous vocal cords	Helium and oxygen tent; 25% oxygen, 75% helium	3½ days	Patient dropped off in a sound sleep with slower and less obstructed breathing; after laryngoscopy 3 days later extreme respiratory obstruction developed, which was gradually relieved for 8 hours by helium and oxygen; recurrence of edema necessitated tracheotomy; discharge 2 months later	Recovery
5 1 yr. M	Following a cough, rapid and labored breathing developed, with signs of retraction below the sternum for 2 days; patient showed edema of the epiglottis and pharynx	Helium and oxygen tent; 25% oxygen, 70% helium	1 day	Considerable relief of dyspnea took place, and 24 hours later retraction of chest had largely disappeared and tent was removed; patient discharged 5 days later; diagnosis, acute laryngotracheitis, pharyngitis and tonsillitis	Recovery
6 9 yr. F	Cough and increasing dyspnea for 12 days; bronchoscopic removal of tooth	Helium and oxygen tent; 25% oxygen, 75% helium	2 days	Considerable relief obtained from mixture of helium and oxygen; after 2 days obstructive dyspnea was decreased, although still present, and tracheotomy was performed; patient discharged 5 weeks later	Recovery
7 1 yr. M	Cough for 4 days, followed by stridor and obstructive dyspnea	Helium and oxygen tent; 25% oxygen, 70% helium	.....	Dyspnea considerably relieved, and after 2 days patient was removed from tent, without reappearance of stridor; discharged 4 days later	Recovery
8 16 mo. F	After bronchoscopic removal of pea, marked obstructive dyspnea occurred	Helium and oxygen tent; 25% oxygen, 70% helium	1 day	Immediate relief took place, but next day respiration again became difficult and tracheotomy was performed; patient discharged 2 weeks later	Recovery
9 3 mo. F	Sore throat and dyspnea 4 days; retropharyngeal abscess, draining; temperature 107 F.; patient very ill	Benedict helmet apparatus; 22% oxygen, 74% helium	2 days	Infant showed definite although slight improvement in dyspnea and marked improvement in restlessness; progressive amelioration of all symptoms with removal; convalesced in 2 days	Recovery
10 6 wk. F	Stridor since birth, with increasing dyspnea for 3 days before admission; marked retraction of suprasternal, intercostal, subxiphoid and subcostal spaces; lungs clear; atmosphere of 90% oxygen reduced cyanosis but did not relieve dyspnea	Helium and oxygen tent; 24% oxygen, 68% helium	8 days	Marked relief of signs of obstructive dyspnea; patient rested quietly; at end of 8 days dyspnea persisted outside tent; tracheotomy done, with relief of dyspnea; 3 months later baby suddenly died; autopsy showed soft tumor in tracheal wall, with erosion of innominate artery	Death
11 4 mo. M	After laryngoscopy and esophagoscopy, with removal of tack from esophagus, marked dyspnea, cyanosis and retraction of muscles of neck	Helium and oxygen tent; 30% oxygen, 70% helium	1 day	Both cyanosis and dyspnea largely cleared in atmosphere of helium and oxygen; next day a series of 6 to 8 coughing spells, with dyspnea temporarily	Death

11 4 mo. M	After laryngoscopy and esophagoscopy, with removal of tack from esophagus, marked dyspnea, cyanosis and retraction of muscles of neck developed; atmosphere of 90% oxygen relieved cyanosis, but dyspnea persisted	Helium and oxygen tent; 30% oxygen, 70% helium	1 day	Both cyanosis and dyspnea largely cleared in atmosphere of helium and oxygen; next day a series of 6 to 8 coughing spells, with dyspnea temporarily occurring after them, suggested tracheotomy; bronchopneumonia developed, and patient died 6 days later	Death
12 11 yr. M	Metastases to lungs and mediastinum as a result of sarcoma; rapidly increasing, severe obstructive dyspnea, restlessness and marked tachycardia took place	Helium and oxygen tent; 22 to 25% oxygen, 65 to 70% helium	1½ days	Marked improvement in dyspnea, color, restlessness and pulse rate for 24 hours, when increasing obstruction became evident, with death 12 hours later	Death
13 26 mo. F	For 7 days prior to admission increasing fever, cough and dyspnea; breathing extremely labored, color markedly cyanotic, signs of retraction of chest marked, breath sounds prolonged and wheezing; bilateral otitis media, bacteremia due to a hemolytic streptococcus, bilateral pneumonia	Helium and oxygen tent; 21% oxygen, 75% helium	6 days	Before administration of helium, high oxygen atmosphere improved color, but dyspnea and restlessness were not relieved until a high concentration of helium was employed with 21% oxygen; septic course; child died	Death
14 75 yr. F	Intrathoracic carcinoma of thyroid treated by roentgen rays resulted in increasing obstructive dyspnea, stridor and cyanosis; edema of vocal cords	Helium and oxygen tent; 30% oxygen, 65% helium	4 days	Definite relief of dyspnea and stridor; shortage of supply of helium necessitated removal to oxygen tent; increased dyspnea, unrelieved by intubation and emergency tracheotomy, resulted in death the same day	Death
15 2½ mo. M	Cough and fever for 3 days were followed by marked obstructive dyspnea and cyanosis	Helium and oxygen tent; 30% oxygen, 65% helium	3 hr.	Patient at first seemed to breathe more easily; he was removed from tent and an attempt made to wash out the stomach; infant stopped breathing during the process; diagnosis, rickets and bilateral bronchopneumonia	Death
16 56 yr. F	One day after thyroidectomy for toxic goiter, marked dyspnea with suprasternal retraction and pulmonary edema developed; pulse rate 160	Mouthpiece rebreathing apparatus; 50% oxygen and 50% helium, under pressure of 7 cm. of water	1 day	Within 10 minutes signs of pulmonary edema disappeared; lungs were clear and cyanosis greatly diminished; 12 hours later pulse rate rose to 170 and patient died	Death
17 42 yr. F	For 9 weeks patient had attacks of dyspnea and for 24 hours constant respiratory distress, and for 2 hours she was unconscious; moribund woman with slow, stridorous breathing and marked cyanosis; to the left of the sternum was a large pulsating mass, obviously an aneurysm	Mouthpiece rebreathing apparatus; 21% oxygen, 79% helium	1 hr.	Relief of dyspnea and stridor apparent; because of the hopeless nature of condition helium was withdrawn, with immediate recurrence of stridor, and patient died the same day; at autopsy huge aneurysm exerting marked compression of the trachea was observed	Death
18 3½ yr. M	Patient suffered from leukemia; severe reaction to transfusion; high fever, edema and sloughing of uvula and epiglottis for 2 days; distressing obstructive dyspnea; patient moribund	Helium and oxygen tent; 21% oxygen, 75% helium	½ hr.	Slight to moderate relief of dyspnea obtained with mixture of helium and oxygen in tent; when nurse removed patient for feeding increased dyspnea and death followed	Death
19 4 mo. F	Marasmic infant, ill for 3 weeks with cough and increasing obstructive dyspnea; diagnosis, purulent laryngitis and bilateral lobular pneumonia	Helium and oxygen tent; 28% oxygen, 65% helium	2 days	Dyspnea and cyanosis moderately diminished, but condition became worse, tracheotomy done as a method of last resort, and patient died 3 days after admission	Death
20 5½ yr. F	Sore throat 1 week, severe obstructive dyspnea and laryngeal stridor for 2 days; diagnosis, laryngeal diphtheria	Helium and oxygen tent; 25% oxygen, 65% helium	12 hr.	Patient appeared to show little or no relief from mixture of helium and oxygen, and was transferred to hospital for persons with infectious disease the following day	Transference
21 79 yr. F	After metastatic involvement of neck and mediastinum, stridor and severe obstructive dyspnea with marked signs of retraction of the chest developed	Helium and oxygen hood tent; 23% oxygen and 74% helium, with 2 to 3 cm. pressure first 24 hours	2 wk.	Stridor disappeared almost immediately; subjectively, patient felt relieved, and objective signs of retraction were definitely diminished and gradually cleared; patient free from all dyspnea in air in 2 weeks	Recovery

In the remaining seven cases partial or temporary relief was obtained. In three cases in which tracheotomy was ultimately performed, recovery took place (cases 4, 6 and 8). The remaining four patients were fatally ill, one with compression due to a mediastinal tumor (patient 12), the second with compression due to aneurysm (patient 17) and the last two with bronchopneumonia (patients 13 and 15).

Observation of the patients who received positive pressure in addition to helium and oxygen therapy (patients 1, 9, 16, 17 and 21) led to the belief that pressure would have been an additional help in many of the other cases. In the acute emergencies, especially in infants, the changing picture is not infrequently difficult to interpret. A sudden increase in subglottic edema might obscure the benefit of helium therapy and lead to the conclusion that it was of no influence; contrariwise, swift clearing of the infectious process could be unwittingly described as due to inhalation of helium. In this group the patients were frequently withdrawn from helium in order to be fed, and the sequence of events was observed both by the eye and the motion picture camera. Nevertheless, a patient with chronic and relatively stationary obstruction reveals the effectiveness of this therapy more clearly than one in whom a constantly changing clinical course is present. In case 21, the relief from the addition of pressure to the mixture of helium and oxygen was definite. The retraction of the intercostal spaces was clearly considerably diminished. With the partial melting of the tumor and subsidence of marked constriction of the trachea the mixture of helium and oxygen without pressure was adequate.

In practice, therefore, the hood which makes closure about the neck is preferable to the body tent, since with the former it is possible to maintain pressure of from 1 to 3 cm. in the respired mixture of helium and oxygen. The maintenance of the concentration of helium in this apparatus should be without difficulty if 2 liters per minute of the combined gas is admitted, provided frequent openings into the hood are avoided. A very sick infant or child is often made worse by attempts to feed water or dextrose solution through the mouth when urgent dyspnea is present; in these cases hypodermoclysis is more effective and less burdensome. This generally applies to adults as well. With the hood in situ, attention to the chest and abdomen is not handicapped, and the patient may thus obtain a continuation of the inhalation therapy.

The study of the case histories indicates that in some instances helium and oxygen therapy is entirely palliative. When the obstruction is due to pressure of a neoplasm below the site for tracheotomy the only alternative to treatment with a mixture of helium and oxygen is death by strangulation. In one instance the treatment could be continued until roentgen therapy accomplished removal of the constricting force. If prolongation of life is itself justifiable through the use of roent-

gen therapy, as is supported by common belief, then the employment of helium and oxygen therapy in order to sustain life until an attempt may be made to reduce a tumor by roentgen therapy is indicated. When the pressure is due to an advancing aneurysm, for which there is no medical therapy, it seems pointless to use helium and oxygen therapy and precipitate a situation which would necessitate indefinite treatment.

The most favorable field for this treatment appears to be the inflammatory swellings in the air passages that are due to infection or to mechanical irritation such as instrumentation or the application of medicaments. In cases in this category there is a self-limited factor in the obstruction to respiration. If the patient can be tided over a certain period without suffocation by inhaling helium and oxygen under a slight pressure, the subsidence of the infection or the traumatic inflammation makes complete recovery possible. In cases in which the larynx is the seat of the obstruction, tracheotomy is an entirely possible mode of procedure, which was necessitated in many of the cases in this series. Had pressure been more freely used, we believe the number of patients treated by tracheotomy might have been less. Our purpose is not to minimize the importance of tracheotomy, which is a life-saving measure in itself, but to emphasize that the ability to dispense with tracheotomy by employing helium and oxygen therapy makes less likely the complications following tracheotomy, such as descending infection and bronchopneumonia. In other cases, those in which tracheotomy is indicated, a period of relative relief by the inhalation of helium and oxygen makes the operation less dangerous. Furthermore, when tracheotomy is performed in a case in which long-standing obstruction has been present, preparation should be made to attach a connection to the tracheotomy tube whereby expiration may be made under water and the pressure only gradually lowered, as has already been discussed. For this purpose the tracheotomy tube should not be flush with the neck but should extend beyond it for about ½ inch (1.3 cm.) so that a rubber tube may be attached to it. A Y tube is connected to the rubber tube, one end of which is connected through an inspiratory valve to the air, the other end being connected to the water bottle. The expired air then bubbles off during expiration, the degree of the pressure being gradually lowered in from one to three days. The need of aspiration and suction is thus prevented.

That pressure in the expiratory cycle is employed by the human organism itself in times of stress is shown by the expiratory grunt in lobar pneumonia.[11] That back pressure is produced on the alveolar walls and capillaries will soon become obvious on a little personal experimentation. By grunting into a basal metabolism apparatus and measuring the tidal air as well as the pressure in the tube that led from the

mouthpiece, we were able to measure the pressure suddenly released when the grunt terminated in a violent expiration. In figure 7, it will be seen that a pressure as high as 10 cm. of water was recorded at the termination of an induced grunt, which necessarily represented the pressure in the respiratory tubal system and lungs in the period immediately preceding the grunt. The flat top of the curve for the tidal air before the release of the grunt indicates the time during which the pressure was maintained. The pouring out of seromucous fluid follow-

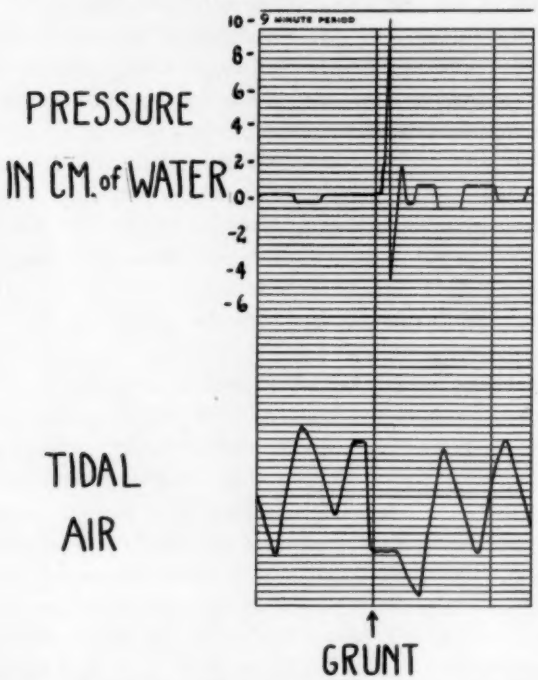

Fig. 7.—Increased positive pulmonary pressure and delayed egress of tidal air during violent grunting respiration. The upper graph shows a pressure which mounts to 10 cm. of water at the start of the expiration. The downward swing of the curve to the negative side at the completion of expiration is due to the momentum of falling water rather than true negative pressure. In the lower graph inspiration is shown by the ascending curve, which has a flat top preceding the grunt, representing the period during which the inflated lungs are held under pressure, the extent of which at the moment of release is revealed in the upper graph.

ing tracheotomy not only may be due to the sudden removal of back pressure against the capillaries in the alveoli and bronchial tree but may serve to create obstruction and therefore back-pressure, preventing

further exudation. The artificial application of pressure prevents further oozing without interfering with the absorption of oxygen or the elimination of carbon dioxide.

SUMMARY AND CONCLUSIONS

The physiologic basis for the use of helium in cases of obstructive lesions in the trachea and larynx is presented. The clinical results of inhalation therapy with the use of helium and oxygen in twenty-one cases are described. In some patients tracheotomy has been averted by this procedure; in others the condition of the patient has been improved, tracheotomy having been required later. In still other cases, in which the obstruction was very marked, helium and oxygen therapy was of no avail. The variable factors which determine the clinical application of this method of treatment are discussed.

CRISTECTOMY

PERMANENT WINDOW IN THE ANTRUM FOR CHRONIC MAXILLARY SINUSITIS

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In the following remarks it is urged that wider use be made of the intranasal operation on the antrum, a procedure surprisingly lacking in popularity, considering its many advantages over the radical operation.

It is agreed generally that intranasal surgical intervention succeeds in most cases of surgical disease of the frontal, ethmoid and sphenoid sinuses. In the case of the maxillary antrum, however, the trend still seems to be in favor of radical measures, in spite of the fact that it has been nearly thirty years since Canfield [1] described the intranasal operation.

The proper selection of treatment for maxillary sinusitis depends on the knowledge and experience of the otolaryngologist. When surgical intervention is necessary, it should be as conservative as is consistent with a cure of the disease.

In certain types of antrum it is desirable to obtain the greater exposure afforded by transoral operation, and in these the Caldwell-Luc or the Denker operation may be used. These are: (1) antrums in which there are partitions, tumors or many polypi, (2) antrums which continue to be infected in spite of previous operations and (3) antrums in which there is infection of dental origin, with disease of the alveolar bone or retained dental roots. These, however, constitute a minority of the abnormal conditions of the maxillary sinus which come to operation. In most cases radical operation is unnecessary, because chronic maxillary sinusitis usually will subside if proper ventilation and drainage are established.

In discussing Skillern's [2] preturbinal modification of the Canfield intranasal operation, Coates [3] stated the belief that once this operation is learned, it should supplant all other nasal operations. However, the intranasal operation has not been used so widely or so often as it deserves

1. Canfield, R. Bishop: The Submucous Resection of the Lateral Nasal Wall in Chronic Empyema of the Antrum, Ethmoid and Sphenoid, J. A. M. A. **51**:1136 (Oct. 3) 1908; Tr. Am. Laryng., Rhin. & Otol. Soc. 1907, pp. 384-393.

2. Skillern, R. H.: Pre-Turbinal Operation on the Maxillary Sinus, Laryngoscope **24**:901-908, 1914.

3. Coates, G. M., in discussion on Skillern,[2] pp. 960 and 961.

because the average otolaryngologist does not appreciate the importance of removal of the pyriform crest, which is a step in the procedure essential to a successful result. This step deserves particular emphasis, for, as Skillern [2] has stated, the intranasal opening tends to close with astonishing rapidity. Because of this, as he has stated also, packing, curettement or applications of caustic may be necessary in the after-treatment. When the pyriform crest is removed, however, exposure is adequate, the interior of the sinus may be inspected and the opening in the inferior meatus remains after the wound has healed, thus providing permanent aeration and drainage. This explains the excellent results of Hempstead [4] and Wachsberger,[5] both of whom remove the crest. Failure to carry out this step explains the poor results many otolaryngologists attribute to the intranasal operation.

Various men have made slight modifications in the procedure, but the principle of Canfield remains the same, namely, exposure of the interior of the antrum by way of the nostril and the inferior meatus, thus avoiding an oral incision and providing for a permanent intranasal opening into the antrum. To stress the importance of the removal of the pyriform crest, it might be better to discontinue the use of such terms as intranasal window or antrostomy and to call the procedure "cristectomy," from the crista pyriformis.

The operation is easy on the patient, and the technic is simple for the surgeon. It requires no assistants, no retractors and few instruments. A total elapsed time of thirty minutes, including that necessary to anesthetize the tissues, usually is ample. There are no loss of tissue from the turbinate, scant, if any, bleeding, hardly any postoperative reaction and minimal injury to the membranous lining of the sinus. The operation provides exposure, ventilation and drainage, the requisites of proper treatment of disease of the sinus. Infection should not recur, because the antrum is aerated permanently. If the septum is deviated or if other sinuses are infected, so that it is desirable to operate on them, this work may be done at the same sitting, valuable time being saved by the use of cristectomy.

Cristectomy done alone may be performed in the office, and if performed in the hospital it rarely requires more than one day's hospitalization or more than two weeks' postoperative care. This operation is particularly valuable when there is a "tooth antrum" with fistula and when it is necessary (as is usually the case) to provide a counter

4. Hempstead, B. E.: Intranasal Surgical Treatment of Chronic Maxillary Sinusitis, Arch. Otolaryng. **6**:426-433 (Nov.) 1927.

5. Wachsberger, Alfred: Endonasal Radical Operation on the Antrum, Arch. Otolaryng. **17**:222-229 (Feb.) 1933.

opening into the nose for drainage of the sinus. Many such fistulas will close without plastic repair when the permanent counter opening is provided.

Objections, whether imaginary or real, can be considered as follows:

1. Exposure is inadequate. The operation never was meant to be completely exploratory. For complete exposure, the transoral method is indicated and the Denker operation is preferable, because it includes cristectomy, with better exposure than is obtainable with the Caldwell-Luc operation.

2. The opening is not permanent. This emphatically is not true, provided the crista pyriformis has been removed.

3. The infection persists or recurs. When the case has been properly selected as to indications and the operation is correctly performed, there is no more reason for recurrence or persistence of infection following cristectomy than following the Denker or the Caldwell-Luc operation. In fact, there may be more likelihood of recurrent infection following a Caldwell-Luc operation than following a cristectomy, because in the Caldwell-Luc operation the anterior acute angle is not exposed, and the crista is not removed, with the result that the naso-antral window frequently closes.

4. Paresthesia of the incisor teeth is produced. This may occur if the bone is removed too low toward the floor of the nose and the antrum. However, it is transitory, and no devitalization of the teeth occurs unless the roots are uncapped with the curet. It is undesirable to use the curet in this operation. Surely, in this procedure there is less danger to the teeth, even with an inexperienced operator, than in the radical method.

5. Bleeding occurs. There should be practically no bleeding at the operation. If the opening is extended too far toward the sphenopalatine canal, bleeding may occur from the lateral nasal branches of the sphenopalatine artery. It is unnecessary and undesirable, however, to extend the opening far backward. Any other bleeding is really an oozing from the soft tissues beneath the ala and is scanty and easily controlled by the use of a cotton pledget or epinephrine or both.

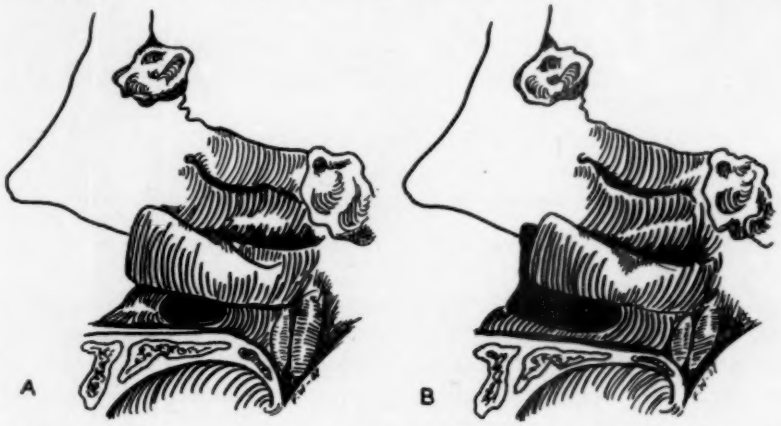
6. Injury to or obstruction of the nasolacrimal ostium is produced. This opening is found just below the attached border of the turbinate, being placed high on the lateral wall of the inferior meatus and about 3 cm. from the anterior nares. Obstruction rarely occurs, although the inferior meatus is the site of some of the most frequent otolaryngologic surgical procedures, and when it does occur it is transitory and not difficult to correct.

There is nothing to add to the excellent descriptions of the technic given by Hempstead [4] and Wachsberger.[5] The essentials are outlined as follows:

1. Preoperative medication with pentobarbital or morphine and scopolamine or both.

2. Local anesthesia: (a) a solution of cocaine and epinephrine is applied topically to the inferior meatus, the inferior turbinate, the region of the sphenopalatine ganglion and the anterior ethmoid nerves. (b) a 1 per cent solution of procaine hydrochloride is infiltrated at the anterior tip of the inferior turbinate, along the lateral wall of the inferior meatus and over the crista pyriformis under the nasal ala. Procaine hydrochloride is injected at the infra-orbital foramen and in the pterygomaxillary fossa, whence it reaches the second division of the fifth cranial nerve and the sphenopalatine nerve.

3. A perpendicular incision divides the soft tissue attachment of the inferior turbinate and exposes the pyriform crest. The inferior turbinate



A illustrates the usual window in the antrum. The crista pyriformis has not been removed. *B* illustrates the correctly made window with the crista removed.

is infracted mesially, and the soft tissues lateral and mesial to the sharp crest are pushed back with a periosteal elevator. The naso-antral wall of the inferior meatus now is broken through with the Wilhelminsky trocar, and this opening is enlarged, both backward and forward. The anterior enlargement is important, and for this the Kerrison mastoid rongeur is almost indispensable. With this instrument one can quickly remove the thick bone of the pyriform crest, which lies laterally and slightly anterior to the tip of the turbinate. Its action can easily be controlled, and the instrument is powerful enough for the thick bone it must bite into. It is desirable to remove the naso-antral wall downward also, so that there is little, if any, eminence between the nasal and the antral cavity. However, the floor of the antrum is nearly always on a level lower than that of the nose, and it is unnecessary to reduce this eminence excessively to obtain efficient drainage. A hand bur or rasp is

sufficient for this and for smoothing the margins of the opening. A flap of mucous membrane may or may not be provided. This is optional with the operator, but it is unnecessary to good healing and a permanent opening, provided the crest is removed.

The antrum is cleaned with suction. No curetting is done unless polypi are found or there is cystic, degenerated and much thickened membrane. If possible, it is better not to disturb the epithelium, because it probably is more efficient physiologically than membrane which has undergone repair or regeneration. Although the preponderance of evidence shown by the considerable recent experimental work on the membrane of the nose and sinuses indicates that there is regeneration of the ciliated mucosa after its destruction or removal, this opinion is not unanimous nor has it been shown that the new or repaired membrane is as efficient as the old.

No packing is used in the antrum. Should oozing occur, it is usually from the soft tissues around the opening and beneath the ala and is controlled easily.

In the after-care, irrigation is not desirable because of the damaging effect of water on ciliated mucosa. As a rule, suction with a cannula is used, but it is not started for four or five days after the operation.

SUMMARY

In the majority of instances, disease of the antrum requiring surgical intervention will respond well to the conservative intranasal operation. A step essential to the success of the operation is best described as cristectomy. The Kerrison mastoid bone rongeur is an almost indispensable part of the set of instruments.

Green's Eye Hospital.

MYXOMA OF THE PALATE AND PHARYNX

REPORT OF A CASE

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AND
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The comprehensive reviews of cases of tumors in the oropharynx which have appeared in recent years make it presumptuous to present the clinical and surgical history of a single patient with a tumor of the palate and pharynx unless there was some unique feature worthy of record. This distinction is accorded because the tumor we observed appears to have been a pure myxoma, adequately diagnosed by trustworthy laboratory studies, both in preoperative biopsy and in postoperative analysis. A pure myxoma at this site is a rare occurrence.

In the splendid studies of New and Childrey,[1] presented before the American Laryngological Association in 1931, observations were reported on three hundred and fifty-seven cases of tumor of the tonsil and pharynx observed at the Mayo Clinic between 1917 and 1930. Among the sixty-three cases reported as instances of tumor, one fibromyxoma and one myxomatous polyp were mentioned, but no true myxoma was included. In their second group—adenocarcinomas of mixed tumor type, tumors potentially malignant but closely resembling the tumor described in this report—they alluded to the same difficulty which we encountered, that of determining the exact site of origin, although they concluded that 56 per cent of the growths arose from the palate.

Bosworth[2] in his textbook recorded three cases in his group of myxofibromas of the palate, but no true myxomas were reported in his chapter on tumors of the soft palate, uvula and pillars of the fauces. He said he considered the pure myxoma as the prevailing type of the nasal polyp. Kaufmann[3] termed these polypoid myxomas, apparently

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Read at the Forty-Third Annual Meeting of the American Laryngological, Rhinological and Otological Society, Inc., Atlantic City, N. J., June 3, 1937.

1. New, Gordon B., and Childrey, J. H.: Tumors of the Tonsil and Pharynx, Arch. Otolaryng. **14**:5 (Nov.) 1931.

2. Bosworth, E. M.: A Text Book of Diseases of the Nose and Throat, Baltimore, William Wood & Company, 1896.

3. Kaufmann, E.: Pathology for Students and Practitioners, translated by Stanley Reimann, Philadelphia, P. Blakiston's Son & Co., 1929.

agreeing with this view, while Dan McKenzie [4] held that the simple nasal polyp is not a myxoma, which is a tumor composed of mucous tissue like Wharton's jelly, but is merely the result of edema and an expression of inflammation. MacFarland,[5] in his earlier textbook of pathology, called nasal and aural polypi which grow from the mucous membrane covering the turbinates and in the tympanic cavity, respectively, myxomas, but in his later book on surgical pathology he stated that nasal polypi, once called myxomas, are known to be edematous fibromas.

In the preliminary study of the case reported here an effort was made to trace in the upper part of the pharynx some postturbinal connection, but careful nasopharyngoscopic studies eliminated any such attachment.

The serial reviews of cases by Furstenberg,[6] Goldsmith [7] and Sonnenschein [8] of tumors in this area include only tumors of the mixed tumor type. According to the last-named authority, mixed tumors of the soft palate are comparatively rare, with a total number of reported cases probably less than fifty, and this rather coincides with the findings of New and Childrey. The true myxoma is again not included in the group, though it is clinically benign. Tholen [9] has recently reported a case of myxoma of the soft palate and the right tonsillar area with myxomatous degeneration.

In general pathologists are of the opinion that mucous tissue as such does not exist in the body, and when it uncommonly appears in pure form it is probably derived from some embryonal cells that are able to form connective tissue mucin. The myxoma is a tumor composed of loose connective tissue, with branched cells and intercellular substance of mucinous fluid, closely resembling Wharton's jelly of the umbilical cord and the vitreous humor of the eye.

As a tumor it is slow in growth, without much tendency to metastasis, and it is frequently not recognized until obstructive symptoms appear.

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4. McKenzie, Dan: Diseases of the Throat, Nose and Ear, London, William Heinemann, 1937.

5. MacFarland, Joseph: Surgical Pathology, Philadelphia, P. Blakiston's Son & Co., 1924; A Text Book of Pathology, Philadelphia, W. B. Saunders Company, 1910.

6. Furstenberg, A. C.: A Clinical and Pathological Study of Tumors and Cysts of the Nose, Pharynx and Mouth of Teratological Origin, Tr. Am. Laryng. A. **58**:231, 1936.

7. Goldsmith, Perry G., and Ireland, P. E.: Mixed Tumors of the Nose and Throat, Ann. Otol., Rhin. & Laryng. **45**:4 (Dec.) 1936.

8. Sonnenschein, Robert: Mixed Tumors in the Soft Palate, Arch. Otolaryng. **11**:137 (Feb.) 1930.

9. Tholen, E. F.: Myxomata of the Jaw and Pharynx, Tr. Am. Laryng., Rhin. & Otol. Soc., 1936, p. 608.

True myxoma occurs in subcutaneous and subserous connective tissues, along nerve trunks, in endocardial areas, in relation to tendons, periosteum and joints and in mammary glands.

In a somewhat careful search for types of pure myxoma reported in the current literature of the past ten years, its rarity was confirmed. Reports of less than fifty cases in this group were found. The lesions were widely distributed, including a dozen cardiac types, and not over half that number were even remotely connected with the pharyngeal area. While in this search the term myxoma was accepted to mean pure myxoma, it does not completely preclude the occasional admixture of fibrous, cartilaginous and other combination types, and it is not assumed that even the majority of cases of minor growth were reported. In view of the infrequency, indeed the almost entire absence, of reports of myxomas in the oropharynx, it seems justified to report our case because it is unusual, particularly as no embryologic significance was noted at the time of examination or in the subjective history.

REPORT OF CASE

The patient, a girl of 14, was referred by Dr. Batchelor, of the Palmerton Hospital, to the surgical service of one of us (Dr. Pfeiffer) at the Lankenau Hospital of Philadelphia, on Oct. 8, 1936. The chief complaint was of a painless growth in the mouth of three months' known standing. This was reported to have followed a severe sore throat which lasted for one week. As this subsided the patient noted a marked swelling in the right side of the oropharynx, with marked thickening of the speech. During this three month period the swelling had been incised three times, but only blood was obtained. One needle biopsy was made, disclosing myxomatous material, considered probably benign but possibly malignant.

After the preliminary examination the patient was referred to the otolaryngologic department for study and treatment. Physical examination revealed no marked abnormality except a massive swelling involving the entire right side of the palate and half of the left side, extending back into the upper part of the pharynx and downward below the level of the right tonsillar fossa. The uvula was drawn far to the left. Between it and the right pharyngeal border were scars of former incisions and needling. There was slight fulness in the right side of the neck from the angle of the jaw downward. This swelling was soft and not painful to the touch. The swelling in the mouth gave the "feel" of fluid contents, speech was fairly clear and swallowing was somewhat difficult.

There was no familial history. Although the mother reported that the patient was in an automobile accident six years before and sustained an open wound of the skull near the vertex on the same side as the present tumor, resulting in a fracture of the skull and followed by eighteen hours of unconsciousness, there seemed to be no logical connection with the present condition.

The patient had some deafness for five months before she was aware of the tumor. An audiometric chart showed that the hearing at this time was 28 per cent below normal on the right (tumor) side, but careful nasopharyngoscopic examination showed the upper part of the pharynx to be clear; no involvement was noted around the mouth of either eustachian tube, and there was no connection

between the tumor and any of the structures of the nasal turbinate. Roentgen examination of the sinuses gave negative results and indicated no involvement of the bone in either the pharyngeal or the cervical region. There was no disturbance of pulse, respiration or temperature. Laboratory findings were not significant. Examination of the blood showed: red cells, 4,000,000; white cells, 6,300, with neutrophils, 63 per cent; lymphocytes, 35 per cent, and large mononuclears, 2 per

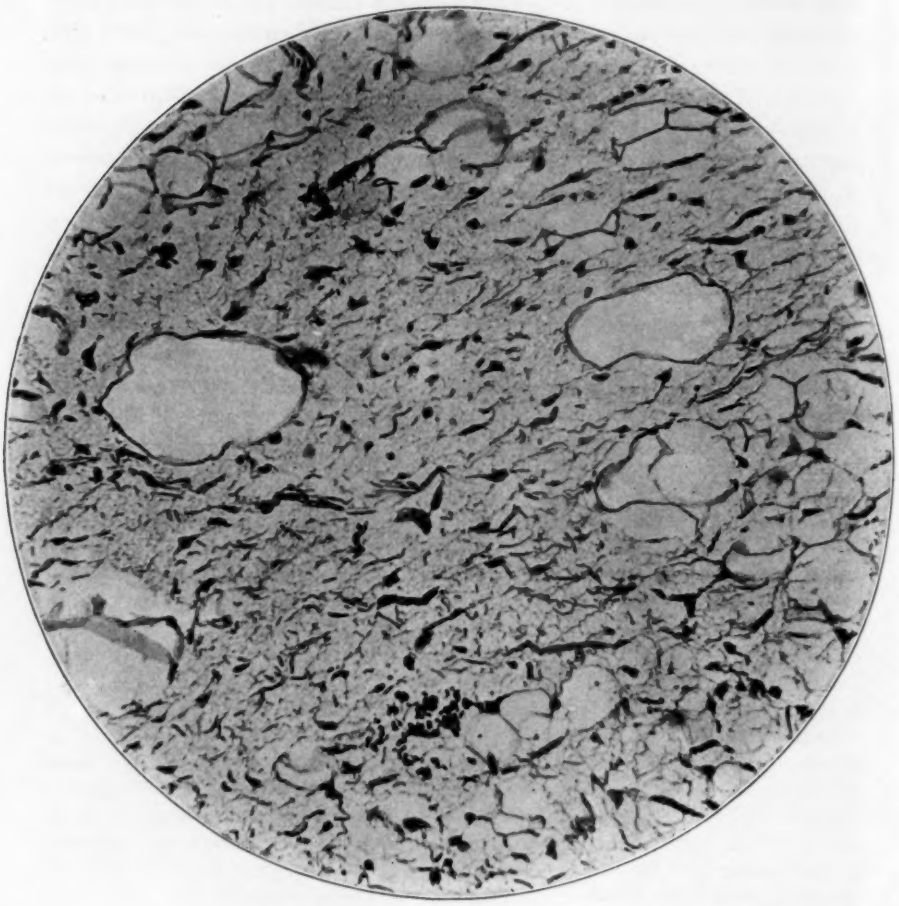

Fig. 1.—A section from the myxoma.

cent; sugar, 70 mg., and urea, 17 mg. per hundred cubic centimeters. The basal metabolic rate was minus 6, and the Wassermann and Kahn reactions were negative.

Two days after the patient's arrival at the hospital an incision was made about 2 cm. to the right of the displaced uvula. After a definite capsule was pierced, several small portions of white friable gelatinous tissue were removed for study. Dr. Reimann pronounced these myxomatous tissue, benign and probably resistant to radiation. There was free bleeding as the result of removal of biopsy material,

which was controlled by pressure. The patient was carefully watched during the period of healing. The case was discussed in the tumor clinic of the hospital, and complete removal with preliminary ligation of the right external carotid artery was advised.

Operation and Course.—On October 27, with the patient under anesthesia induced by tribromethanol in amylene hydrate (avertin) and continued by nitrous oxide, oxygen and ether administered intratracheally (Dr. Havens), the right external carotid artery was first ligated (by one of us [Dr. Pfeiffer]) with a no. 2 double chromic suture just above the exit of the superior thyroid artery. This was exposed through a small transverse incision to the level of the hyoid bone and dissected down to the junction of the sternocleidomastoid muscle and the superior belly of the right digastric muscle. After the removal of a small lymph node the wound was closed with clips.

The tumor was then removed (by Dr. Campbell and one of us [Dr. Babbitt]) in a fairly bloodless field through a 3 cm. curved incision about midway between the normal position of the uvula and the right lateral wall of the pharynx. This incision was above and external to the area scarred by the removal of biopsy material. After the capsule was reached, most of the mass was enucleated by

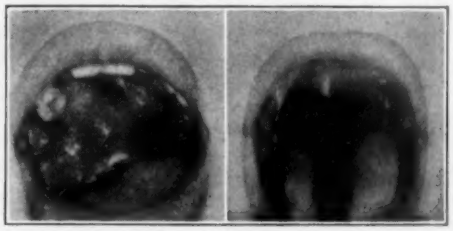

Fig. 2.—The mouth of the patient before and five months after the removal of the tumor.

dissection with the fingers. It finally ruptured, however, at the scarred area, and the balance of soft jelly-like material was removed with Kelly and spoon forceps. The cavity was ovoid, 6 or 7 cm. in the long diameter and extended back to the prevertebral fascia of the pharynx, around the angle of the jaw and well down into the right pyriform fossa. The incision was extended downward to permit dependent drainage. There was a moderate amount of venous hemorrhage, and one small artery was tied at the base of the tongue after removal of all vestiges of the tumor mass and the capsule. At the suggestion of one of us (Dr. Pfeiffer), the cavity was swabbed out with a solution of pure phenol and packed with dry gauze. A portion of the palate was resected, including the traumatized area from which the specimens had been taken for biopsy, to restore the position of the uvula. A portion of the latter was removed. A small opening was maintained in the neighborhood of the lower right molars with gauze drainage for about four weeks.

The pathologic diagnosis was myxomatous tumor of the palate and pharynx.

The patient was discharged on December 5, thirty-nine days after the operation, in good general and local condition, with the palate in proper position. At that time she chewed food and swallowed easily, but the nasal quality of speech continued, and she was referred to the university speech clinic.

The patient reported early in March 1937, three months later, with no evidence of recurrence or metastasis. The palate and pharynx were in good order, and the speech was improved.

The patient reported two months later. Although the family physician had incised a small vesicle over the left tonsil in April 1937, releasing a few drops of clear fluid, this was not mucoid material, and there has been no recurrence of the tumor at the time of writing.

CONCLUSIONS

The consensus among pathologists is that pure myxoma is comparatively rare.

Practically all similar tumors of the oropharynx and nasopharynx reported have been of the mixed tumor type.

In the case reported there has been no evidence of recurrence or metastasis in about six months.

Preliminary ligation of the external carotid artery on the side principally involved and intratracheal anesthesia are advisable.

The plastic reconstruction of the palate after the removal of a large mass presents no difficulty.

The return of normal speech has been slow but progressive.

1912 Spruce Street.

Clinical Notes

BALLOON TAMPON AFTER RADICAL MASTOIDECTOMY

IRVING WILSON VOORHEES, M.D., NEW YORK

Twenty-five years ago I was taught to pack every radical mastoidectomy cavity with iodoform gauze. This procedure was carried out for many weeks and months, gave untold suffering to the patient and tried the patience of the surgeon. After that came the use of stents, mostly those made from paraffin or some form of wax. They were a decided improvement and are still much used.

In skin grafting it has been a problem to hold the grafts in place. Dench used small Thiersch grafts held by tiny pellets of cotton dipped in an antiseptic powder. This method has merit but is time consuming and laborious. It occurred to me that it is much simpler to use a sterilized finger cot and blow it up with air from a syringe, tying off the neck with silk and doubling it over so that air may be well retained. After the grafts are carefully laid, the cot is placed through the mastoid wound deep in the tympanic area without in any way disturbing the grafts. The cot is then tied to the tip of a syringe and air is forced into it slowly until the desired amount of pressure is obtained. The rubber will, of course, expand in all directions and thus make uniform pressure throughout the cavity. If too much pressure is exerted, the skin will become necrotic. One needs just enough to make the balloon protrude from the auditory canal from ¼ to ½ inch (0.6 to 1.2 cm.). The posterior wound is then closed by metal clips, and the usual external dressing is applied. Sometimes it is well to leave the lower angle of the wound open for drainage. It is seldom necessary to disturb the dressing before the fifth day. The rubber bag may be removed on the seventh day. By this time the grafts should show definite attachment. If the discharge is foul, physiologic solution of sodium chloride followed by hexylresorcinol or iodine powder may be used daily for a week or two. Healing then goes on normally to complete epidermization.

140 East Fifty-Fourth Street.

Progress in Otolaryngology

Summaries of the Bibliographic Material Available in the Field of Otolaryngology

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ACUTE AND CHRONIC PURULENT OTITIS MEDIA, SINUS THROMBOSIS AND SUPPURATION OF THE PETROUS PYRAMID

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Progress in otolaryngology is found not to show a curve rising progressively. To one who has made the survey each year from the time these summaries were first begun an unevenness in progress is apparent. The literature for 1936 reveals little that is new. However, progress is not always made by the presentation of new ideas or discoveries but depends much more on newer comprehensions of established facts and particularly on the coordination and interpretation of old ideas. During the year under survey much was written, but this was new neither in the originality of the material concerned nor in the observations presented. The foreign otolaryngologists have taken and accepted the outstanding American contributions toward the study and understanding of suppurative lesions of the petrosal pyramid, and their literature is now rich in contributions, all of which in a large measure are corroborative of the American point of view.

PURULENT DISEASE OF THE TYMPANUM

It has long been a common observation that once suppuration of the middle ear has become firmly established it assumes one of two courses. In some instances the perforation in the membrana tympani heals, while in others a permanent defect remains. In Wittmaack's [1] classic work is to be found the first rational explanation of this diversity of tissue reaction. It is his contention that the method of the reparative process is dependent on the type of tissue in which the suppuration has played its rôle. The type of epithelium which exists in a given tympanic cavity holds the key to the kind of reaction which will ensue once invasion by bacteria has been established.

From the Department of Otolaryngology, Beth Israel Hospital.

1. Wittmaack, K., in Henke, F., and Lubarsch, O.: Handbuch der speciellen pathologischen Anatomie und Histologie, Berlin, Julius Springer, 1926, vol. 12.

Clinically, Stinson [2] has approached this problem and presents interesting observations. He cites instances in which he has observed a definite migration of the epidermal layer of the tympanic membrane. He found that the epidermis migrated from the back forward. Places on the drum were marked with india ink, and repeated observations revealed that the area so marked moved in a definite manner from the posterior portion of the drum toward the anterior part. In the area of Shrapnell's membrane the migration of the epidermis took place in a fan-shaped pattern toward the superior wall of the canal, while in the region of the short process the movement of the skin occurred in whorls. It is not clear what practical deductions can be drawn from these observations. Stinson feels that herein may lie a means for the procuring of closure of persistent perforations. However, in view of the fundamental observations of Wittmaack, Stinson's conclusions cannot be substantiated. The practical application of his observations, however, is still to be awaited, since the movement of the dermal layer of the drum has been mooted before.

All students of the anatomy of the temporal bone are aware of the variations from what is termed normal, and every observation recalling an abnormality which carries with it dangerous implications is indeed welcome as a guide in the avoidance of untoward dangers. Thus, an anomalous dehiscence in the tympanic floor with the dome of the jugular bulb protruding upward so as to fill part of the hypotympanum becomes of practical import when the ear drum requires incision to evacuate purulent material within the tympanic cavity.

Federici [3] reports a case of a 6 year old boy in whom profuse hemorrhage resulted after myringotomy. The author clearly established the point of origin of the bleeding as the dome of the jugular bulb and made a study to determine the frequency of the occurrence of a high-lying bulb. In the examination of 2,456 temporal bones he found this anomaly 34 times. In 9 specimens the bulb was especially high and definitely occupied space within the tympanic cavity.

Another anomaly of the jugular bulb is reported by Kono.[4] In his case he observed a bluish white swelling on the floor of the external auditory canal located external to the membrana tympani. Puncture of this swelling resulted in profuse pulsating bleeding.

In the earlier days of otology many studies were undertaken of the bacterial flora which invades the middle ear and its adnexa and attempts

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2. Stinson, W. D.: Reparative Processes in the Membrana Tympani, Arch. Otolaryng. **24**:600 (Nov.) 1936.

3. Federici, F.: Le emoraggie da paracentesi della membrana timpanica e la frequenza ed il significato, Arch. ital. di otol. **48**:145, 1936.

4. Kono, Y.: Die Blosslegung des Bulbus jugularis im Gehörgang, Zentralbl. f. Hals-, Nasen- u. Ohrenh. **26**:474, 1936.

were repeatedly made to correlate to a given type of bacterial invasion a definite clinical picture. These studies, while of intense interest, did not in the long run give any results of practical bedside utility. By and large, the tissue reactions which resulted locally seemed to be about the same regardless of what type of bacteria was found to be the causal agent in a given case. To be sure, certain organisms seemed to have, and have since been proved to have, inherent specific reactions, and these were soon understood and clinically identified. From the clinical standpoint there came to be recognized the painless type of lesion, and the specific asymptomatic course of pneumococcic infection of the middle ear has filled a large part of the literature. Likewise, the diphtheria bacillus produces a characteristic lesion. The tubercle bacillus among others gives specific reactions. Later, tissue reactions within the middle ear and the mastoid process were established as being more influenced basically by the anatomic structures than by the infecting agent which brought the inflammation into being. In addition, the comprehension of the structure on which a bacterial invasion occurred prognosticated the clinical course to a degree of certainty. Therapy then followed these lines and was effective. Nevertheless, certain organisms showed definite reactions as characteristic sequelae to their entrance into the middle ear, and Brodbeer [5] comments on this in his report of 2 cases of mastoiditis caused by the type I pneumococcus. He states that this organism caused severe toxic symptoms from the onset of the disease, which were followed by a prompt alleviation of all symptoms subsequent to the administration of type I pneumococcus serum (10,000 units).

Saprophytic organisms rarely offer serious problems, and they seldom cause fatal lesions. McGovern [6] cites 2 cases, however, in which Bacillus proteus assumed virulent characteristics. In both his cases the infection followed chronic purulent disease in the middle ear. He suggests the use of autogenous vaccines against B. proteus, and he further states that satisfactory results have been obtained on several occasions with this therapy.

The incidence of nephritic complications in the presence of acute infection of the middle ear has been reported often. That there is a relationship between the severity of the otitic infection and the damage to the kidney by the same etiologic agent is a fact which has been noted clinically. The most frequent observation is that the renal lesion is usually secondary to the aural disease. Sometimes the two lesions occur concomitantly, caused as they are by a common infection. I have cited

5. Brodbeer, W. H.: Two Cases of Pneumococcal Mastoiditis, J. Laryng. & Otol. **5**:394, 1936.

6. McGovern, F. H.: Fatal Otogenic Infection with Bacillus Proteus: Report of Two Cases, Arch. Otolaryng. **24**:618 (Nov.) 1936.

such cases in these summaries and have reported cases which I have observed. Therapeutically, the indication for prompt surgical eradication of the aural infection is presented, and this procedure is followed by good results. When the kidney has been subjected too long to the toxic irritant, resolution of the nephritic lesion following surgical treatment of the ear may be delayed. That the otitic lesion may produce the renal involvement is comprehended. What is not so well known is the part which the diseased kidney plays in retarding the recovery from otitic purulent disease. The report of experimental work in this connection is therefore important. Hiroto,[7] utilizing chemical agents, injured the kidneys of laboratory animals. These were then infected with a virulent strain of Streptococcus haemolyticus. Control animals with normal kidneys were likewise subjected to otitic infections. At the end of the third week it was noted that the animals with normal kidneys presented definite signs of healing otitic suppuration. On the other hand, those of which the kidneys had been damaged showed definite evidence of necrosis of the mucosa of the middle ear and purulent coalescence of the bony walls of the tympanic cavity. Microscopically, round cell infiltration of the haversian canals also was demonstrable. From these observations of Hiroto one may draw the conclusion that early operative intervention is indicated in suppurative lesions of the middle ear in the presence of a pathologic condition of the kidneys. Since the latter reacts unfavorably on the local lesion in the ear and inhibits its resolution, the sooner the vicious cycle is broken the better will be the end-results following therapy.

That great dependence is placed by otologists on the roentgenologic findings is too well known to need additional comment, but the final decision as to diagnosis and therapy must continue to rest on the clinical observations of the otologist. Because of the difference in stress and interpretation, confusion has often resulted. Thus, Zangemeister[8] notes the discrepancies found in the literature between the roentgen studies of pneumatization and the findings of the state and phase of pneumatization clinically when a patient is operated on and the diseased part of the temporal bone is visually inspected. In 2 cases this observer found a well pneumatized bone on roentgen examination, whereas at operation a spongy type of bone was encountered. He notes that the spaces interpreted roentgenologically as air spaces really were filled with a fatty type of bone marrow. He terms this finding pseudopneumatization. Perhaps something in the hardness of the ray, the time of exposure and the thickness of the patient's skull

7. Hiroto, S.: Experimental Studies on the Influence of Nephritis on Middle Ear Infections, Mitt. a. d. med. Akad. zu Kioto **15**:697, 1935.

8. Zangemeister, H. E.: Pseudopneumatization, Arch. f. Ohren-, Nasen- u. Kehlkopfh. **140**:187, 1935.

bones may have accounted for this variance in findings. After all, the roentgenogram depicts only shadows, which are dependent on the power of penetration of the ray used, and any variation may account for discrepancies of similar types of anatomic structure. Halisteresis can, of course, be determined by the experienced observer, as can sclerosis and coalescence. Roentgenograms of any one patient taken at different angles and with different concentrations of rays will present different anatomic findings.

Worning's [9] sane outline of what the otologist should expect from the roentgenogram of the mastoid process is pertinent to the discussion. From his study of 600 cases he concludes that an alteration in cell structure produced by an infection may persist for a long time after the acute purulent otitis has healed. In reporting on films the roentgenologist should take into consideration such persisting alterations when he summarizes his findings in order to formulate his indications for operative intervention. Worning, too, states that as a rule the roentgenogram and the operative findings rarely agree. He believes that perisinal and extradural abscesses can be and should be diagnosed by means of the roentgenogram. In chronic purulent disease he was unable to differentiate disturbances of pneumatization from necrosis of the bone per se. In a series of 36 cases of cholesteatoma he was able to diagnose this lesion in only 8.

The problem presented when the eburnation of the bone occurs in the mastoid process is still a moot question for some. Not long ago the current opinion was that the presence of eburnated, or sclerosed, bone was the after-effect of chronic suppuration and an end-result of long-continued inflammatory reaction. Ziegler [10] undertook to study this question. He approached the problem to determine whether the thickening of the cell walls which was evident after an infection of the mastoid process could end in sclerosis of the process. His histologic examination revealed that, particularly when a large amount of destruction took place with formation of cavities and eventual deposits of new bone at the periphery of the mastoid, there was always a large central lumen remaining. In other words, sclerosis as it is found in chronic disease did not follow long-continued suppuration. He examined 100 bones serially sectioned and found no evidence that sclerosis was the outcome of prior infection of the bone. Thus, histologic support is given to the negative side, which substantiates the point of view of those who believe with

9. Worning, B., and Jörgensen, A.: Der Wert der Roentgenuntersuchungen bei entzündlichen Erkrankungen im Os temporale, Ztschr. f. Laryng., Rhin., Otol. **26**:325, 1935.

10. Ziegler, E.: Knochenneubildung bei Mastoiditis, Ztschr. f. Hals-, Nasen- u. Ohrenh. **39**:159, 1936.

Wittmaack that sclerosed bone in the mastoid process is a variation from the normal type of pneumatization.

The unsettled question of infantile otitic infection and gastro-intestinal disturbances still engages the attention of investigators, and agreement between pediatricians and otologists seems no nearer. However, a more rational common point of view is emerging. Hitherto, one school of thought sought the origin of all nutritional disturbances in infants in what was termed latent otitic infections and another group of observers held to the view that the otitic infection was not to be considered as etiologic in these cases. I have repeatedly refused to accept the foreign conception regarding latent otitic infection. I have always contended that there is no such pathologic or clinical entity. An infection either does or does not exist. When it does exist, there is an underlying bacterial invader which produces local tissue reactions, and the systemic effects of bacterial invasion and inflammatory tissue reactions are present as a consequence. Once the infection has ceased to exist, the local tissue reactions subside, either rapidly or gradually, leaving in their wake in some instances more or less permanent local tissue changes which can be regarded as the result of reparative processes or as scars. It is histologically and bacteriologically inconceivable that an infection can go on indefinitely without apparent reactions, both local and systemic. Rather, I consider these cases to be instances of reinfection, with all the local tissue reactions produced by a reinvasion by pathogenic bacteria. György [11] observed two types of infantile otorrhea. One, which is secondary to the common cold or follows an attack of vomiting, presents frank aural symptoms, but generalized systemic symptoms are absent; the other type presents meager signs from the ears but, on the other hand, shows marked nutritional and systemic symptoms. This observer feels that patients with the latter type should be subjected to operation, all other means failing to control the nutritional disturbances. Huinink,[12] too, noted the frequency of acute purulent otitis media associated with gastro-intestinal disturbances in infants. He holds that the paucity of local aural symptoms can be accounted for by the egress of pus through the wide open and short eustachian tube of these infants. He, too, notes the scantiness of frank pus at operation. Huinink, who terms this condition latent otitis, believes it responsible for the nutritional disturbances and contends that operation is indicated after all other means to control the gastro-enteritis have failed. He believes pus within either the infantile mastoid process or the tympanic cavity to be an agonal finding not characteristic of the pathologic picture in the living patient. Of

11. György, E.: The Rôle of Otitis in Disease of Infancy, Orvosi hetil. **80**: 139, 1936.

12. Huinink, A. T. B.: Otitis bei Saüglingen, Maandschr. v. kindergeneesk. **4**:219, 1935.

his 7 patients the 2 who were submitted to operation recovered, and the other 5, not operated on, died. He believes that the latter might have recovered had each had antrotomy performed. Csapo [13] adds another conception to the problem by distinguishing between septic, toxic, septicotoxic, autogenic and meningeal forms of sepsis among these patients. All persons with autogenic sepsis give evidence of metastatic foci. The toxic types mostly produce the nutritional and systemic disorders. He holds the view that all aural infections play a definite rôle in the nutritional disorders of infancy, but he endeavors to draw a differentiation between the infections which produce the constitutional disorders and those which do not. Only through such differential diagnosis can effective therapy be evolved.

As one reads the extensive literature on this topic, one is impressed by the general opinion that when the infantile nutritional disturbance cannot be improved and the gradual physical decline cannot be stopped by medical means, then an otitic focus must be sought. Drainage of the aural spaces is indicated, even when one is in doubt as to its causal relationship to the general condition. All other means failing to bring relief, paracentesis of the membrana tympani or antrotomy should be undertaken despite the paucity of otitic symptoms. Zanetti,[14] Ribadeau-Dumas, Ramadier, Guillon and Melletier,[15] and György [16] all take this view. The value of paracentesis alone needs an extra note. In these young patients the mastoid process is undeveloped. The antrum lies high. There is actually no development of the posterior bony meatal wall, and by extending the paracentesis upward one may hope to effect antral drainage through Shrapnell's area. On the other hand, the reduplication of the membranous folds in Prussak's space, filled to some extent with postembryonal tissue, when subjected to low grade infection becomes thickened and thus impedes adequate drainage through the incision into the membrana tympani. Hence, antrotomy is often more effective as a surgical therapeutic measure.

Otologists are interested in pseudocholesteatoma and are constantly meeting this pathologic entity in practice. Its genesis and development are generally comprehended, but the experimental production of cholesteatoma has not thus far yielded new conceptions. Hoshiya [17] undertook

13. Csapo, J.: Die Bedeutung der Mittelohrentzündung und Mastoiditis im Säuglingsalter aus pediatrischem Standpunkte, Arch. f. Kinderh. **109**:203, 1936.

14. Zanetti, P. B.: La suppurazioni timpaniche ignorate del lattante, Osp. Bergamo **5**:17, 1936.

15. Ribadeau-Dumas, L.; Ramadier; Guillon, and Melletier: La mastoïdite du nourrison, Bull. Soc. de pédiat. de Paris **34**:43, 1936.

16. György, E.: Die Rolle der Mastoiditis in der Säuglingsheilkunde, Arch. f. Kinderh. **108**:13, 1936.

17. Hoshiya, H.: Experimental Studies Concerning the Complications of Middle Ear Cholesteatoma, Mitt. a. d. med. Akad. zu Kioto **14**:1299, 1935.

such an experimental study. He employed various chemical agents to act as irritants, and after producing a lesion in the drum, succeeded in creating cholesteatomas in mice. He found that the same complications ensue in the experimental animals as are found clinically in man, with one possible exception. Erosion more often took place through the cochlea in his mice than is found to occur clinically in human beings. I believe that this finding is not significant and that this happened frequently in his experimental animals because he selected the site of the intrusion. This observer further reports that abscesses of the brain were found to be the result of direct extension. His finding of a few instances of inflammatory infiltration of the blood vessels and his conclusion from this observation that extension of the cholesteatoma by a hematogenous route cannot be ruled out definitely are of interest. I believe that this particular observation and conclusion are open to question. The ingrowth of a cholesteatoma is not an inflammatory infiltration. Its development denotes pressure factors which obliterate blood vessels. I take it that Hoshiya observed what he recorded. That his finding might conceivably have been an inflammatory infiltration of the blood vessels from secondary bacterial invaders is not entirely eliminated as a possibility in his experiment. Otologists are aware of the rôle that secondary bacterial invasions play in clinical cases of pseudocholesteatoma.

Tuberculous otitis still concerns otologists, although in America little is seen of its ravages. Collet and Mayoux [18] discuss two forms of this lesion. One presents a sudden onset of otorrhea accompanied with deafness without pain or fever. Otoscopic examination usually reveals multiple perforations of the membrana tympani. Such a condition runs a protracted course. Rapid spread of necrosis of the bone takes place, and the signs of facial palsy and symptoms of labyrinthitis are often presented. The second form of tuberculous otitic disease is more frequently found than the one just outlined. This form of tuberculous infection of the spaces of the middle ear more nearly resembles the ordinary type of otitic infection. It occurs after the common cold. It often presents fever and severe pain. The prognosis in this form of tuberculous lesion is good, but healing always is slow. The essence of the tissue reactions is such that although their onset is typified by an acute phase the usual course of the disease tends toward producing a chronic infection. Collet and Mayoux, like others who have studied tuberculous lesions of the ear, feel that it is not a primary but a secondary involvement and find its genesis either in the lungs or in the lymphatic system. Of course, the early eradication of a tuberculous focus is highly desirable. Hence, stress has been put on early recognition and diagnosis of the lesion.

18. Collet, F. J., and Mayoux, R.: La tuberculose de l'oreille, Bull. méd., Paris **50**:140 (Feb. 29) 1936.

To make this more possible, Lüscher and Rotmann [19] advocate the employment of aural microscopy. Lüscher has perfected an instrument for such study. It gives a magnification of from ten to twenty times and should prove useful. Examination of the membrana tympani with this instrument in 20 patients demonstrated that they were divided into two groups. In one group tuberculous nodes were observed on the tympanic membrane, having a dimension of from 0.2 to 0.5 mm. These nodes appeared as milky white or yellowish elevations. They proved to be small tubercles. They were not necessarily the forerunners of multiple perforations. The second group presented on the membrana tympani dirty gray-white nodules on which the veins appeared greatly dilated. The outer (dermal) layer of the drum head appeared intact. Eventually, of course, breakdown of the tissue ensued. This group is the one in which a chronic type of destruction of bone occurred.

The question of surgical operation to handle chronic lesions affecting the spaces of the middle ear engaged the attention of von Soubiron.[20] He contends that chronic tympanomastoid suppuration with a posterosuperior perforation requires no operative intervention, provided no cholesteatoma is present. He states that epitympanic suppuration needs only so-called conservative radical mastoidectomy. He does his operation thus named without disturbing the membrana tympani or the ossicles. When he is confronted by an acute exacerbation of the chronic lesion, especially when there exists a perforation leading into the attic, he advocates only the modified radical operation. Von Soubiron approaches the lesion endo-aurally. He prefers this route of approach to the usual postauricular incision and entrance into the mastoid process, especially when he is confronted by a wide external auditory canal and when the mastoid process is sclerotic.

This observer, when confronted with an acute exacerbation of a chronic lesion, waits until the acute phase of the infection subsides and then proceeds with his endo-aural operation.

In view of the imminent danger of intracranial complications which an acute exacerbation of a chronic lesion entails, especially when lodged in a sclerotic type of bone, I hardly find myself in accord with the expressed rationale of a procedure in therapy which exposes a patient to such dangers. The only reason presented for delaying surgical intervention to obviate dangerous complications evidently resides in the necessity for permitting the acute phase to pass so that endo-aural surgical operation may be employed successfully to cure the chronic condition. I believe that when one is faced with an exacerbation of a

19. Lüscher, E., and Rotmann, S. S.: Typische otomikroscopische Befunde der Mittelohrtuberculose, Ztschr. f. Hals-, Nasen- u. Ohrenh. **39**:10, 1935.

20. von Soubiron, N.: The Conservative Surgery of Chronic Middle Ear Suppuration, Rev. argent. otol. **4**:191, 1935.

chronic lesion in a sclerosed bone, only prompt surgical intervention will spare the majority of patients from intracranial complications, and I doubt the surgical judgment which would subject a patient to the risk of waiting. No plea for improved surgical technic can invalidate this argument. Far better, once a chronic process of this type is recognized and all attempts to secure healing by other means have proved unavailing, to perform a surgical operation at once and eliminate the lesion. To await the advent of an acute exacerbation to complicate the indications for surgical intervention aggravates the gravity of the prognosis and jeopardizes the outcome of the immediate surgical therapy in question.

In these summaries I have repeatedly expressed similar views when reporting observations which tend to stress procrastination in resorting to adequate radical surgical operation to relieve a chronic disease process. The onset of symptoms from an exacerbation of the chronic condition is not the factor which makes intervention unavoidable. In the presence of such a situation surgical operation is, of course, imperative, but during the study of the chronic condition, long before the advent of any exacerbation, operative therapy adequate to meet the needs presented by the lesion should have been advised and, whenever possible, performed.

THE LATERAL SINUS

The anatomists do not report anomalies as often as do the surgeons. Reports of anomalies in the course of the lateral sinus within the mastoid process are exceedingly rare. Hoople [21] cites a case in which at operation on the right side the lateral sinus was found to terminate at the knee. No sinus was present along the inner table of the mastoid process. The patient died of otitic sepsis, and at autopsy it was observed that the transverse sinus on the right side ended at the knee and then merged and continued outward and downward as the mastoid emissary vein.

Fortunato [22] raises an interesting question as a result of his histologic studies of the walls of the sinus. He examined 40 patients in whom no infection of the ear had been noted at any time. He observed hyaline degeneration of certain areas within the connective and elastic tissues of the walls of the sinus. He thinks that these areas may conceivably present a "locus minoris resistentiae" and may be the factor in the location of a future thrombus. The question then remains—are some persons, more than others, prone to sinus thrombosis because they have areas of hyaline degeneration? How to establish that a given living person has areas of hyaline degeneration in his veins remains

21. Hoople, G. D.: Anomaly of the Lateral Sinus: Report of a Case, Ann. Otol., Rhin. & Laryng. **45**:1019, 1936.

22. Fortunato, V.: Ricerche istologiche sulla labilità costituzionale del seno laterale, Valsalva **11**:686, 1935.

unanswered. The finding is interesting, but in the present state of knowledge it is of little, if any, practical value.

Wasowski and Samborski [23] experimentally produced thrombosis of the jugular bulb and vein in guinea-pigs. They sought information as to whether thrombosis in this area affects the vagus nerve and produces disturbances of its function. They report that disturbance of the vagus nerve follows when there is venous thrombosis. When the thrombosis is surgically removed, the dysfunction of the vagus nerve subsides.

The difficulty of determining the side on which septic sinus thrombosis has become seated in the event of bilateral mastoiditis is generally appreciated. Numerous tests have been devised, among the best known of which is that of Tobey and Ayer. Freedman [24] proposes a new test. He introduces a 4 cm. needle into the internal jugular vein between the mastoid process and the anterior insertion of the sternocleidomastoid muscle. The patient lies on his side during the test. The needle is attached to a manometer. Normally, a pressure of from 200 to 300 mm. of mercury is immediately recorded. When sinus thrombosis is present on the tested side, there is retardation in the recording of the pressure. After insertion of the needle the pressure slowly and gradually rises to a maximum, in contradistinction to the rapid attainment of the maximum normal pressure when the vein is not thrombosed. If the patient is under anesthesia, a slightly higher reading of pressure will be obtained.

From a study of the frequency of occurrence of sinus thrombosis in relation to the type of bone on which the infection of the middle ear becomes located, Gadolin [25] makes this observation: Among 1,000 persons with acute purulent otitis media 184 came to surgical operation, and of these 23 acquired septic sinus thrombosis. Two of these died. The author feels that thrombosis develops more frequently in poorly pneumatized bones, and he states that in these cases the infection reaches the greater blood vessels through the tributaries in the bone. One can hardly accept this conclusion without question. When non-pneumatized or poorly pneumatized bone is presented, the accepted signs of mastoiditis are less likely to be clinically evident as early as they would be in the presence of good pneumatization. Therefore, patients with non-pneumatized bones who fail clinically to present the usual signs and symptoms which are generally taken to indicate mastoidectomy are almost always

23. Wasowski, I., and Samborski, J.: Pathologisch-anatomische Veränderungen im Bereich des N. vagus, die durch eine künstlich gesetzte Thrombose in der Vena jugularis interna hervorgerufen wurden, Monatschr. f. Ohrenh. **69**:1244, 1935.

24. Freedman, L. M.: Puncture of the Internal Jugular Vein in Cases of Mastoiditis, Arch. Otolaryng. **23**:29 (Jan.) 1936.

25. Gadolin, H. R.: Klinische Studien über die durch akute Mittelohrentzündungen verursachte sinusthrombose, Acta Soc. med. fenn. duodecim **20**:1, 1935.

kept too long under expectant observation. The lesion meanwhile progresses and eventually clinical signs appear which are recognized as typifying sinus thrombosis. It is not so much the type of bone which predisposes to the development of the thrombosed blood vessels in these cases as it is the failure to evaluate properly the non-pneumatized bone as a factor in setting an indication for timely surgical intervention before the advent of sepsis signals a lesion in the vein. Gadolin's observation is correct; his conclusion is debatable; nevertheless, his study has instructive angles and deserves serious consideration.

Among 4,961 cases of otitic infection Meltzer [26] found the sinus involved in only 3 per cent. He finds that the cases fall into three groups. First, those in which the condition is diagnosed before surgical intervention on the mastoid process is undertaken. They present evident symptoms of sepsis from the start. Secondly, those in which septic symptoms significant of a lesion of the sinus develop in from one to three days postoperatively. Finally, those in which a sinus complication develops many days after the original operation. Meltzer finds the age of predilection to be between the tenth and the twentieth year. Irrespective of whether the internal jugular vein was ligated, this observer found the mortality in the cases he studied to be between 20 and 30 per cent. He found the death rate to be more dependent on the virulence of the organism and the degree of the patient's resistance than on the evident success of any particular operative procedure or technic. I wonder at that generalization! How does this author estimate the virulence of the organism in the given case so as to make a summation? Likewise, the use of the term "patient's resistance" is open to scientific question. When a patient dies, his resistance to the infection certainly fails; but in the scientific estimation of the factors which produce death, certainly more data are necessary before the generalization can be accepted. It is well recognized that it is impossible surgically to isolate the infection in the blood vessels. The spread from anastomosing veins has never been satisfactorily handled. It is true that early recognition and eradication of the thrombotic focus in the lateral sinus and the jugular bulb have sufficed in many instances, with or without ligation of the internal jugular vein. When the petrosal condylar and vertebral veins become involved, no surgical procedure which has yet been devised will handle the situation. In considering mortality from septic sinus thrombosis, therefore, these factors also must be taken into account. Finally, Meltzer's observation that metastasis in joints is more frequent after ligation of the jugular vein than when the internal jugular vein is not ligated is astonishing. What possible reason could underly the development of metastasis in the joints

26. Meltzer, P. E.: Treatment of Thrombosis of the Lateral Sinus: A Summary, Arch. Otolaryng. **22**:131 (Aug.) 1935.

when a ligature has been thrown about the internal jugular vein? My own experience indicates that metastasis in the joints happens most frequently when sinus thrombosis is diagnosed late and operation is delayed in the presence of sepsis while one awaits the finding of positive results of blood culture. Other misleading factors may also delay the prompt institution of surgical treatment. Meltzer's observations are provocative, and it is desirable that the questions raised be further studied.

Bazzana [27] discusses spontaneous postoperative hemorrhage from the exposed lateral sinus which happens in the period of after-treatment. He reports 6 cases in which bleeding occurred spontaneously from the sinus within from two to five days postoperatively and a septic temperature then developed. He believes the reasons underlying the occurrence to be a spread of necrosis in the sinus walls which eventually permits rupture to occur. He also thinks that the use of puncture of the sinus wall for diagnosis may be a factor. Likewise, trauma from chiseling and slight abrasion by splinters of bone may cause it. The treatment is obvious. Rapid plugging of the bleeding vein should be made. When a sinus is exposed for inspection and its walls are found diseased, discolored and of irregular thickness to the touch, it is better to obliterate the area by plugging above and below it and eradicating it. The use of puncture as a means of diagnosis should be dropped. It gives little useful diagnostic data and potentially tends to create thrombosis. When a sinus is exposed in the mastoid process, its wall should be protected from gauze by a layer of rubber dam between it and the packing so as to prevent tearing of the wall, because the gauze may adhere to it in places. With these precautions taken, the bleeding will be reduced considerably. A lengthy review of the entire question of the management of otitic sepsis is presented by Marx,[28] while Hofer [29] confines himself to a study of metastatic infections occurring in otitic sepsis of children. These secondary complications, he finds, occur most often in the course of chronic purulent otitis media. In earliest infancy the metastatic lesions occur in the thorax most frequently.

THE PETROSAL PYRAMID

In 1930 Balan[30] made a report in co-authorship with Belinoff on the structure of the temporal bone. Since then he has studied 100

27. Bazzana, E.: Emoraggie postoperatorie da necrosi spontanea del sino laterale, Ann. di laring., otol. **35**:88, 1935.

28. Marx: Die otogene Sepsis, Ztschr. f. Hals-, Nasen- u. Ohrenh. **38**:3, 1935.

29. Hofer, I.: Metastasenbildung bei otogener Pyämie im Kindesalter, Wien. klin. Wchnschr. **49**:42 (Jan. 10) 1936.

30. Balan, M.: Ueber die anatomische Struktur der Pyramidenspitze, Zentralbl. f. Hals-, Nasen- u. Ohrenh. **25**:681, 1935-1936.

temporal bones. He finds that the structure of the apical portion and that of the mastoid process generally are similar in a given bone. In 40 per cent of the specimens this was absolutely the case. In 52 per cent there was a close resemblance. In 8 per cent the apex of the pyramid showed a different structure from that of the mastoid process. There is a practical angle to his finding that a sclerosed mastoid process may be associated with a petrosal pyramid which is more or less pneumatized. In this situation it is, of course, conceivable that, without any coalescence of the mastoid process because of its sclerosed type of bone, a tympanic infection may spread into the cellular petrosal pyramid, undergo coalescence there and present a typical lesion, with its concomitant clinical picture. Balan's finding of this type of anatomic structure in 3 per cent of his specimens stresses the importance of bearing it in mind when evaluating a clinical picture in which roentgenologically these findings are present. One other comment is pertinent. The study of anatomic specimens does not always determine exactly whether the cells found are the remains of air cells or of marrow-containing cells. Hence, the percentage of undeveloped pneumatized petrosal pyramids may be revised when this factor is taken into account in further studies. At other times, however, Balan's work substantiates his earlier reports.

In a clinical paper which presents an excellent summary of the literature on petrositis, Lumsden [31] adds a report of 9 cases in all of which palsy of the sixth cranial nerve was present. He significantly stresses that gradual recovery from paralysis of the sixth nerve indicates the onset of recovery. This confirms my personal observations on palsy of the sixth nerve which is present prior to operative intervention for the relief of petrositis. The prompt postoperative recession of the paralysis usually indicates that recovery from the lesion is under way. Regarding these paralyses of the sixth nerve, Rebattu and Colrat [32] present data in addition to those already on record demonstrating that the paralysis of the abducens nerve observed in the course of otitic infections is not characteristic of one particular lesion, and they substantiate further the original report made by Almour and myself [33] on this topic. Rebattu and Colrat, among others, list petrositis, meningitis and toxiconeurotic conditions. In the absence of trigeminal pain these authors find paralysis of the abducens nerve significant as a sign of a cerebellar abscess.

31. Lumsden, R. B.: Some Remarks on Gradenigo's Syndrome and Petrositis, J. Laryng. & Otol. **51**:150, 1936.

32. Rebattu, J., and Colrat, A.: Les paralysies oculaires au cours des otitis et mastoïdites, Rev. d'oto-neuro-opht. **13**:565, 1935.

33. Kopetzky, S. J., and Almour, R.: The Suppuration of the Petrous Pyramid: Pathology, Symptomatology and Surgical Treatment, Ann. Otol., Rhin. & Laryng. **39**:996, 1930; **40**:157, 396 and 922, 1931.

Adams [34] divides petrosal involvement into two types—one in which an inflammatory reaction exists in the petrosal pyramid but spontaneous resolution promptly sets in and another in which there is a developmental step in the progress of the lesion toward eventual meningeal involvement. He describes the first type as rather frequent in occurrence but often unrecognized for what it is. He finds these cases among children who make a slow recovery after simple mastoidectomy. The absence of localizing signs is stressed. The presence of continued fever and a poor pulse is noticed. Adams, however, while calling attention to his two types of involvement has hardly advanced clinical management of the condition, since he fails to give differential diagnostic signs of practical bedside value. While he calls attention to the frequently overlooked lesion, he does not stress his exact method of recognizing involvement of the first type.

Blohmke [35] adds a clinical warning regarding those cases in which meningitis develops late in the course of otitic infection and says he believes that late involvement occurs as a sequel to rupture of a lesion through the tip of the pyramidal apex. His article is taken up with a general discussion of the various routes traveled by infection toward the endocranium. He notes the tympanomastoid route, the route via the blood channels and nerves and the one through the structure of the petrosal pyramid.

Richter [36] makes a report covering ten years. He describes the study of 14 patients with suppuration of the petrosal pyramid. Six of these patients recovered. Paralysis of the abducens nerve was present 7 times and trigeminal pain 9 times. Four of his 6 patients who recovered were healed when the purulent material in the pyramid was spontaneously evacuated through a gravity abscess which emptied into the pharynx. In the other 2 patients a gravity abscess finally evacuated underneath the muscles of the neck from the formation of pus under the lateral side of the base of the skull. All the rest of his patients died of meningitis. The report holds therapeutic significance, and physicians in America, who now have available surgical technics to evacuate such a purulent abscess, need not await the haphazard formation and spontaneous evacuation of a gravity abscess to induce healing in cases of petrosal suppuration.

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34. Adams, S., in discussion on Watkyn-Thomas.[43]

35. Blohmke, A.: Die otogenen Hirnhautentzündungen mit besonderer Berücksichtigung der Pyramidenspitzeneiterung, Zentralbl. f. Hals-, Nasen- u. Ohrenh. **26**:699, 1936.

36. Richter, H.: Beiträge zur pathologischen Anatomie des Ohres: Ueber Empyeme der Felsenbeinspitze, Arch. f. Ohren-, Nasen- u. Kehlkopfh. **140**:360, 1936.

Änggård [37] discusses 12 cases of petrositis, in 7 of which death occurred. Palsy of the facial nerve was noted twice and palsy of the abducens nerve only once. He stresses a point repeatedly made by competent observers of this type of infection, namely, the paucity of symptoms. He advocates in all instances of protracted acute suppuration of the middle ear the repeated roentgen examination of the suspected region for comparison and study, so that the developing lesion in the pyramid may be readily recognized. Arnoldson [38] reports an unusual case of chronic purulent otorrhea in which in the later clinical course palsy of the abducens nerve and complete deafness on the opposite side developed. Death from meningitis ensued. Arnoldson believes that the purulent process spread from the affected to the healthy side through the clivus basilaris. Perhaps that may have happened, but I believe that the total deafness in the otherwise healthy ear of the opposite side could with just as much logic be ascribed to the ensuing meningitis, from which death eventually resulted. It is not uncommon in purulent lesions of the meninges to have infiltration of the labyrinthine channels develop from within outward. The route to the cochlea from the subarachnoid space through the internal auditory meatus is just as probable as that through the clivus basilaris.

Arnoldson's recommendation of complete exenteration of the petrous bone including the destruction of the labyrinth seems unnecessary in view of the variety of surgical technics now available which permit complete exenteration of all the structural contents of the petrosal perilabyrinth without disturbing either the labyrinth or the facial nerve. When a functioning labyrinth is present, it is now no longer necessary to sacrifice this structure to eradicate the purulent lesion in the perilabyrinthine portion of the petrous bone.

In the application of roentgen examination to assist in the diagnosis of petrosal lesions, Nager [39] feels that Stenver's position gives the most useful information. He further adds that serial studies are necessary to obtain this objective. With these contentions I am fully in accord, but in addition, I use the plate taken in the base position. The study of films taken in both positions greatly aids roentgen diagnosis of this lesion. Another reporting favorably on the use of the Stenver's position is Kraus.[40] His report embraces 3 cases of otitis due to type III pneu-

37. Änggård, G.: Beitrag zur Klinik der Apizitiden, Acta oto-laryng. **23**:101, 1935.

38. Arnoldson, N.: Ueber die Pathogenese und Therapie der Apizitis, Acta oto-laryng. **23**:96, 1935.

39. Nager, F. R.: Zur Diagnose und Therapie der Eiterungen in der Felsenbeinspitze, Schweiz. med. Wchnschr. **2**:615, 1935.

40. Kraus, L.: Roentgenologische und histologische Untersuchung zur Petrositis, Ztschr. f. Laryng., Rhin., Otol. **26**:209, 1935.

mococci. In 2 of these cases there was a definite relationship between the petrosal lesion and the terminal fatal meningitis. Kraus makes a significant observation. He cautions that wide exposure of the dura of the middle and of the posterior cranial fossa is not without danger. He says that the dura in this area is easily torn, especially if it has previously undergone inflammatory changes. I have often widely exposed the dura of both the middle and the posterior cranial fossa in cases of streptococcic meningitis, eviscerating almost the entire structure of the temporal bone lying posterior to the tympanic cavity and taking away the mesial walls of the mastoid process entirely including its tegmen but leaving intact the cochlea and the facial canal and avoiding the posterior portion of the petrosal ridge because tearing is almost unavoidable. I have done this many times in otitic streptococcic meningitis. Other otologic surgeons have also reported using this procedure, and they as well as I have had a number of patients fully recover. I therefore doubt the importance of the warning of Kraus when the surgeon is faced with the desperate situation this type of case presents. This, of course, does not entail the exposure and elevation of the dura beyond the subarcuate fossa and the extension of this toward the apical portion of the pyramid.

Rosen and Kaplan,[41] realizing the difficulties met with in approaching the petrosal pyramid surgically through the middle cranial fossa after either simple or radical mastoidectomy, try to ease the approach by lessening intracranial pressure. They advocate accomplishing this by performing a preliminary ventricular puncture, and they contend that thus the approach to the pars petrosa subtentorially is facilitated because the dura of the middle cranial fossa is more easily elevated. Theoretically, of course, the intracranial pressure is lessened, but the dural attachments to the petrosal ridge remain just as adherent as before and must be separated. It is the structural adhesions and not the intracranial pressure that present the difficulty. In the presence of an infected area the small tears and scratches and minor traumas which the dura sustains in these attempts to separate it from the bone present an added danger which tends to infect the meninges at the traumatized sites within the pars petrosa. My objection to drainage established from above is augmented for this reason. Finally, after Rosen and Kaplan's procedure has been carried out and the purulent lesions in the anterior parts of the pyramid are drained, the purulent material is actually led past the traumatized dura, thus further inviting infection of the tissues. If a rupture is encircled by an epidural abscess, these factors do not obtain. In this situation, in the presence of increased

41. Rosen, S., and Kaplan, A.: Ventricular Puncture Preliminary to Operation for Acute Suppurative Petrositis, Arch. Otolaryng. **23**:35 (Jan.) 1936.

intracranial pressure, resort might profitably be had to the procedure advocated by Rosen and Kaplan.

Kleinfeld [42] contributes a case report in the discussion of which he stresses the timing of the operative intervention on the petrosal lesion. He believes that when the pain from the fifth cranial nerve changes from the characteristic retro-orbital or supra-orbital area, becomes more generalized to extend over the entire forehead and takes on a constant throbbing intensity, this indicates that rupture of the purulent focus has taken place through the apical portion of the petrous pyramid. While the observation may be correct, it remains desirable to reach and eradicate this lesion before rupture takes place. To me it seems that Kleinfeld has timed the rupture of the lesion rather than indicated the best time at which to intervene surgically.

Watkyn-Thomas [43] discusses various methods of evacuating purulent material from within the petrous pyramid. He favors the technic advocated by Eagleton. He states that no objection should be entertained to performing radical mastoidectomy in these cases, since life itself is at stake. He makes another observation in that he contends that "the amount of hearing which survives a severe petrositis is usually negligible." He is disinclined to follow a particular routine of surgical attack in these cases, finding it more important to follow pus tracts and provide for their egress rather than to preplan a surgical technic and carry it out in all cases. In this he finds support from Sir James Dundas-Grant.[44] In the summary of the literature on this topic from England comment must be made on the address made by Kisch [45] before the Section of Otology of the Royal Society of Medicine. Kisch comprehensively summarizes the entire topic, clearly outlines the clinical picture and recommends surgical therapy.

Heretofore, no surgical technic has been presented which, in the first place, made reachable the anterior labyrinthine area which rests against the posterior cranial fossa. Furthermore, no technic has heretofore been advanced which permitted exenteration of the contents of the petrosal pyramid analogous to the exenteration used in simple mastoidectomy and at the same time permitted leaving the labyrinth and the facial canal unaffected. Lempert [46] presents such a technic. Finally,

42. Kleinfeld, L.: Petrositis with Operation and Recovery, Arch. Otolaryng. **24**:503 (Oct.) 1936.

43. Watkyn-Thomas, F. W.: The Treatment of Petrositis, J. Laryng. & Otol. **51**:252, 1936.

44. Dundas-Grant, J., in discussion on Watkyn-Thomas.[43]

45. Kisch, H.: Petrositis: A Review of Recent Work, Proc. Roy. Soc. Med. **29**:263, 1936.

46. Lempert, J.: Complete Apicectomy: Preliminary Report of a New Technic, New York State J. Med. **36**:1210 (Sept. 1) 1936.

when it is found necessary, his operative procedure permits removal of the inner table of the petrosa in a manner exactly similar to that which all otologists use in removing parts of the inner table of the mastoid process. His procedure approaches the carotid artery after radical mastoidectomy and the necessary dural exposure as a preliminary step. The anterior wall of the bony external canal below the level of the petrosquamous suture which guards the structures of the mandibular joint is removed to bring the artery into view. The carotid portion of the pars petrosa is then exposed by successive steps until the temporal portion of the external carotid artery is in full view. Ruptures of the inner table can be recognized and eroded areas eradicated. The whole operative procedure takes place anterior to the cochlea. All the petrosal surfaces can be viewed. The operation should be studied in the original communication. I have been impressed with the possibilities of this operation. It has one great distinction in that the integrity of the cranial cavity is not violated, and no step in the procedure brings the dura into more contact with purulent material than happens when the tegmen or the inner table is removed during ordinary mastoidectomy. I have performed the operation and have had recovery following its use in cases deemed to fit the technic it entailed. Death has not occurred in any of the 3 cases in which I have employed it.

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Abstracts from Current Literature

Ear

HEARING DEFECTS IN BEHAVIOR PROBLEMS. MATTHEW MOLITCH and EDGAR M. ADAMS, J. Juvenile Research **20**:15 (Jan.) 1936.

Studies were made with audiometers on 480 inmates of a home for boys. Defective hearing was associated with a lower intelligence level in this group than in the rest of the population. A high incidence of defects of hearing was found in children with otitis media and syphilis. The third largest group comprised those with reading defects and the next lower groups were made up of children with the so-called psychopathic personality, endocrine disturbances and problems of discipline.

FERGUSON, Niagara Falls, N. Y. [ARCH. NEUROL. & PSYCHIAT.]

CLINICAL AND INSTRUMENTAL VESTIBULAR REACTIONS IN A CASE OF UNILATERAL ACUTE LABYRINTHITIS, FOLLOWING SLIGHT ACUTE OTITIS. J. A. BARRÉ and A. CHARBONNEL, Rev. d'oto-neuro-opht. **14**:246 (April) 1936.

Labyrinthitis following acute otitis is rare. The case is reported of a girl aged 17, who after acute catarrhal otitis on the left side suddenly became dizzy, with nystagmus to the right, vomiting and tinnitus. The symptoms lasted two days and were then relieved by vigorous blowing of the nose, only to return two days later, accompanied by slight fever. Warm and cold caloric tests on the diseased ear produced no reaction; the tests on the sound ear which should have reversed or annihilated the preexisting vestibular syndrome were without effect, while those that acted in the direction of the spontaneous phenomena reenforced them strongly. The various excitations (rotatory, thermic and galvanic), when applied to the two ears therefore had only one effect: that of exaggerating the existing manifestations. Reexamination twenty-eight days later revealed no clinical signs of disturbance in vestibular function. Instrumental tests showed lack of reaction to the caloric test in the right ear and a slight reaction in the left. There was a subnormal response to rotation in both directions. The poor and partial responses to stimulation are explained by assuming that the cure was not complete. Attention is called to the results of the experiments of Bauer and Leidler and others, who observed that in an animal with one cerebral hemisphere removed provoked nystagmus was more accentuated in one direction, depending on which vestibule was stimulated.

DENNIS, San Diego, Calif. [ARCH. NEUROL. & PSYCHIAT.]

OTOVESTIBULAR STUDY OF TWENTY-SIX CASES OF CLOSED CRANIOCEREBRAL TRAUMATISM. M. MEULDERS and J. HELSMOORTEL JR., Rev. d'oto-neuro-opht. **14**:449 (July-Aug.) 1936.

It is as essential to make a complete vestibular examination in cases of trauma as to examine the auditory function. To the classic tests of Bárány have been added tests of the otolithic apparatus described by Quix. Nystagmus itself has become complex. Quix has proved that it is caused by excitation of all the canals and not of one only and that it is the result of an ampullofugal or an ampullopetal endolymphatic current. Vertical, rotary or diagonal nystagmus is always of central origin; violent spontaneous nystagmus not accompanied by deviation of the arms is likewise of central origin. In peripheral disturbances nystagmus and deviation of the arms are in the same direction. If nystagmus and deviation of the arms are in different directions, the origin is central. In the study of the

present group of cases, special importance has been given to Quix' tests, especially the test for saccular sensibility, since the object sought here is the demonstration of a peripheral lesion.

Protocols of twenty-six cases are given. Otolithic disturbances were present in fourteen cases; hyperexcitability of the maculae was observed much oftener than paresis. Vestibular tests gave normal results in six cases, hypo-excitability in nine and hyperexcitability in four; in five instances hypo-excitability was observed for certain tests and hyperexcitability for others. In three cases symptoms of disturbances of central origin were present. Great importance is attached to spontaneous deviation of the index finger (past pointing), the side affected corresponding to the side of the lesion. Romberg's test gave positive results six times, and the sensitized Romberg test, four times. The caloric test was more sensitive than the rotatory. The galvanic test was useful on nine occasions in determining the territory involved.

DENNIS, San Diego, Calif. [ARCH. NEUROL. & PSYCHIAT.]

MILIARY TUBERCULOSIS OF THE PETROSAL APEX IN SECONDARY TUBERCULOSIS OF THE MIDDLE EAR. H. RICHTER, Arch. f. Ohren-, Nasen- u. Kehlkopfh. **141**: 167, 1936.

After general remarks about tuberculosis of the middle ear, Richter points out that the process occasionally involves the pneumatic system of the mastoid and the perilabyrinthine portions of the petrosa. Further, he describes clinical and anatomic observations which he made in a case of bilateral miliary tuberculosis of the petrosal apex. In this case it could not be definitely decided whether the bilateral miliary tuberculosis of the petrosal apex had originated in the lungs or in the middle ear. That the latter is possible is proved by a case that was reported by Altmann; however, the author is inclined to believe that in his case it originated in the lungs. The case is important in that it demonstrates that "silent" tuberculous foci may exist in those portions of the petrosa to which the approach during the lifetime is most difficult. Doubtless this is possible also without the existence of tuberculosis of the middle ear, and thus it may even be overlooked at necropsy when the apex is not histologically examined. The author thinks that miliary tuberculosis of the petrosal apex is more frequent than it appears. The consideration of this possibility indicates how justified is the demand to refrain from surgical intervention in tuberculosis of the middle ear, unless a considerable involvement of the pneumatic system of the mastoid makes intervention necessary.

EDITOR'S ABSTRACT.

LATE COMPLICATIONS AFTER RADICAL OPERATION. A. TOBECK, Arch. f. Ohren-, Nasen- u. Kehlkopfh. **141**:236, 1936.

Tobeck describes two cases of late complications after radical operation. The first case was an instance of a relapse of cholesteatoma with episinusal abscess; the second, one of chronic destructive labyrinthitis with cerebral abscess in the brachium conjunctivum. In the first case, the after-operation effected cure, but the second case had a fatal outcome. The author reviews twenty-two other cases of late complications after radical operation on the ear. He emphasizes that if clinical signs indicating an intracranial process develop in a patient who has undergone a radical operation, the surgical cavity should be considered as the site of origin, particularly if the cavity is not dry. Surgical intervention will doubtless disclose a late complication in many cases, and this should then be treated like a primary otogenic complication. The prospects of cure are similar to those of primary complications.

EDITOR'S ABSTRACT.

BILATERAL TUMOR OF THE AUDITORY NERVE AS A COMPONENT OF GENERALIZED NEUROFIBROMATOSIS. L. KRAUS, Fortschr. a. d. Geb. d. Röntgenstrahlen **53**: 793 (May) 1936.

A 9 year old girl had exhibited the multiple tumors characteristic of Recklinghausen's disease since she was 1 year of age. At 18 months she commenced to display evidence of progressive impairment of hearing, and this was followed some years later by mental deterioration. By 9 years she was almost completely deaf. Roentgen examination revealed changes in the contour of the porus acusticus internus on both sides; biopsy confirmed the neurofibromatous nature of the cutaneous tumors and, by inference, established securely the cause of deafness.

Neurofibromas of the eighth nerve are usually bilateral. Similar cases have been reported previously; the peculiar importance of this one lies in the fact that the diagnosis was confirmed by the roentgenogram.

McCUNE, New York. [AM. J. DIS. CHILD.]

THE QUESTION OF THE REACTION OF THE SEMICIRCULAR CANALS IN MAN TO RECTILINEAR ACCELERATION. G. SCHUBERT, Ztschr. f. Hals-, Nasen- u. Ohrenh. **39**:470, 1936.

Schubert points out that de Kleijn and Magnus maintained that not only angular acceleration but also rectilinear acceleration causes a deviation of the cupula and with this a stimulation of the crista because the endolymph spaces and the perilymph spaces are not rigidly closed. These authors proved their opinion regarding the effect of linear acceleration in experiments with a model apparatus. Schubert points out further that the same opinions are expressed in some textbooks. He decided to investigate the reaction of the semicircular canals to rectilinear acceleration. After formulating the problem he describes and evaluates his experiments. He shows that since the system of semicircular canals under the influence of high constant centrifugal acceleration reacts with additional reactions in the same manner to angular acceleration (produced by active movements of the head) or to additional angular acceleration (produced by acceleration described by Coriolis) as to the acceleration of gravity alone, and since the centrifugal acceleration is equivalent to rectilinear acceleration, the system of semicircular canals is not stimulated by such acceleration. The opinion of de Kleijn and Magnus that rectilinear acceleration as a result of the deviation of the endolymph causes deviation of the cupula and with it stimulation of the crista does not apply to the semicircular canals of man, for these react only to angular acceleration.

EDITOR'S ABSTRACT.

SIGNIFICANCE OF OTITIS MEDIA AND MASTOIDITIS IN INFANCY. J. CSAPÓ, Orvosi hetil. **80**:284 (March 28) 1936.

In infancy otitis media cannot be regarded as a local illness, because it may cause general symptoms, especially dehydration. The incision of the drum is not enough; mastoidectomy should be performed. The fact that manifest mastoiditis does not always cause toxic symptoms does not speak against the fact that occult mastoiditis cannot cause toxic disorders. The extent of the focus is not in proportion to its effect. GÖTTCHE, Budapest, Hungary. [AM. J. DIS. CHILD.]

Pharynx

INSPIRED FOREIGN BODY IN A NEWLY BORN INFANT. C. L. MORAVEC, Arch. Pediat. **53**:426 (June) 1936.

A 6 week old infant inspired a cinder ¾ by ½ inch (2 by 1.3 cm.) in dimensions. One and a half hours after the administration of epinephrine the patient coughed up the foreign body. No roentgenograms were taken while the cinder was

in the respiratory tract. Afterward roentgenograms were taken to determine the comparative densities of cinder, coal and stone. The cinder was as opaque as the stone, but almost no shadow was cast by the coal.

ORR, Buffalo. [AM. J. DIS. CHILD.]

TONSILLECTOMY BY DIATHERMY (ELECTROCOAGULATION). M. P. BOEBINGER, New Orleans M. & S. J. **88**:750 (June) 1936.

Boebinger enthusiastically recommends electrocoagulation as a commendable adjunct to orthodox surgical treatment of the tonsils. It is especially advised in cases in which surgical removal is contraindicated for any reason.

He does not consider it the method of choice in children, though he has used it 7 times in children aged 6 to 12 years. In 3 of these cases the adenoids were also removed.

Crystals of cocaine hydrochloride were preferred for anesthesia, but a 2 per cent solution of nupercaine was occasionally used.

Multiple sittings and a meticulous technic are stressed. He considered his results satisfactory in 90 per cent of his 200 cases.

No case has been made for the use of this method in children.

BERKLEY, Los Angeles. [AM. J. DIS. CHILD.]

THE EFFECT OF EARLY TONSILLECTOMY ON THE INCIDENCE OF ACUTE RHEUMATISM. H. L. WALLACE and A. BROWNLIE SMITH, Edinburgh M. J. **43**:452 (July) 1936.

Wallace and Smith differ with two earlier authors from Scotland, who had concluded that early tonsillectomy may prevent the first attack of rheumatism as well as recurrence. The present report concerns two groups of children, 403 of whom underwent tonsillectomy before the age of 5 years, 7.2 per cent suffering later from chorea, rheumatic fever or carditis before leaving school; rheumatism occurred in 4.2 per cent of the 574 children whose tonsils were removed during the later years of childhood. Scarlet fever later developed with about the same frequency—14.4 per cent in group 1 and 16 per cent in group 2. Tonsillectomy performed at an early age either fails to protect against rheumatism or makes the child more likely to acquire it.

NEFF, Kansas City, Mo. [AM. J. DIS. CHILD.]

IRRITATING COUGH DUE TO INFLAMMATION OF PHARYNGEAL LYMPHOID FOLLICLES —PHARYNGITIS GRANULOSA IRRITANS. R. MODEL, München. med. Wchnschr. **83**:810 (May 15) 1936.

The retropharyngeal lymphoid follicles can cause a persistent cough, as illustrated by the case reported by Model. The condition is overlooked unless the pharynx is examined carefully. Cauterization of the follicles with trichloroacetic acid gives relief.

BRAHDY, Mount Vernon, N. Y. [AM. J. DIS. CHILD.]

Nose

SINUS SEPSIS AND MENTAL DISORDER. R. E. JOWETT, J. Ment. Sc. **82**:28 (Jan.) 1936.

Jowett reviews the work of Graves and his associates (*J. Ment. Sc.* **78**:459 [July] 1932), who demonstrated infection of the sinuses in 818 of 1,000 cases in which examination was made by exploration suction technic. Over 50 per cent of the patients have subsequently been discharged from the hospital for mental diseases, presumably after appropriate treatment. Jowett examined the sinuses in 500 cases of mental disease. He found infection of the nasal sinuses in only 7.6 per cent of the cases. In a series of 184 mentally normal persons used as a control

suppuration of the sinuses was found to be present in no less than 5 per cent. Commenting on the fact that pioneer workers in the field claimed a higher incidence, Jowett states that subsequent investigations may prove that the incidence of infection of the sinuses is much lower; however, even the occurrence of infection in 10 per cent of cases demands attention and treatment. His work shows that the incidence of disease of the sinuses is no greater in patients with mental illness than in the general population. For this reason the relationship to mental disease as an etiologic factor remains obscure.

KASANIN, Chicago. [ARCH. NEUROL. & PSYCHIAT.]

TWO CASES OF INTERMITTENT EXOPHTHALMOS; VARICOCELE OF THE ORBIT. F. HIPPERT, Arch. d'opht. **53**:135 (Feb.) 1936.

Up to the time of this report ninety-one cases of intermittent exophthalmos have been described. Hippert reports two new cases, making a total of four which have been observed in Weill's clinic at Strasbourg. These two cases are fully described and are illustrated by photographs clearly showing the condition. The characteristic features are then briefly reviewed. The condition remains stationary for years, the most serious complication being hemorrhage into the orbit and into the brain. The prognosis for life is good, but that for vision is less favorable. Few patients have recovered spontaneously, and in only four cases has a cure been effected. The author favors sclerosing injections because of the great surgical risk. In neither of the two cases reported was treatment curative. Vestibular symptoms were present in one case, suggesting the possibility of vestibular varices.

S. B. MARLOW, Syracuse, N. Y. [ARCH. OPHTH.]

EXOPHTHALMOS DUE TO A DILATING PNEUMOSINUS OF THE ETHMOID. P. BONNET, Bull. Soc. d'opht. de Paris, February 1936, p. 109.

The term "pneumosinus dilatans" is reserved for a condition distinguished from pneumatocele in that a single cell of a sinus becomes filled with air and gradually increases in size. No mucocele accompanies this condition, and no liquid is found in the cell. In a thesis on this subject by Benjamins, presented at Lyon in 1935, ten cases were recorded. The present report concerns a boy 15 years old who presented himself at the clinic with exophthalmos of the left eye that had followed a severe blow to the left superciliary region. No epistaxis or ecchymosis occurred, but the proptosis was painful. It did not increase. The protrusion was 4 mm. anterior to the cornea of the fellow eye. Visual acuity was reduced to ⅛. The results of rhinologic examination, together with findings shown by a roentgenogram, warranted the diagnosis of ethmoid mucocele. The results of general physical examination were of no importance. However, at operation only a large ethmoid cell crowding the orbital contents was found. When opened this contained only air. Exophthalmos regressed fairly rapidly, and about two weeks later the exophthalmometer reading for each eye was 14 mm. There was no increase in visual acuity in the damaged eye.

L. L. MAYER, Chicago. [ARCH. OPHTH.]

FURTHER EXPERIMENTAL STUDIES ON THE ETIOLOGY OF SCLEROMA. G. EIGLER, Arch. f. Ohren-, Nasen- u. Kehlkopfh. **141**:245, 1936.

In order to determine whether Frisch's bacillus (Bacterium rhinoscleromatis) is actually the cause of rhinoscleroma, Eigler made tests on six Javan macaques. Fresh cultures of Bact. rhinoscleromatis were painted on and injected under the nasal mucosa of these animals repeatedly for periods of from ten to eleven months. The results of this experiment were entirely negative in that none of the monkeys acquired scleroma formations like those of human subjects. Thus, it remains doubtful whether Bact. rhinoscleromatis (the Frisch bacillus) actually causes rhinoscleroma in spite of the fact that the serologic tests seem to indicate it.

EDITOR'S ABSTRACT.

Miscellaneous

OPHTHALMIC SYMPTOMS IN BRAIN ABSCESS. A. COWAN, Ann. Surg. **101**:56 (Jan.) 1935.

Forty-four cases of abscess of the brain form the basis for this report. Of seventeen cases of abscess of the frontal lobe, exophthalmos, swelling of the lids, chemosis of the conjunctiva and pain occurred in five and orbital involvement without exophthalmos in seven. All these findings occurred on the same side as the abscess. There was more or less restriction of either the lids or the eyeballs or both in fourteen cases, and in three of these the sphincter of the iris was also involved. Frank choking of the disks was found in fourteen cases (82.3 per cent) in this group. The average level was about 4 diopters. Of the ten patients with choked disks on whom operation was performed, immediate improvement, which continued to complete recovery, was noted in two, no change until death in four and immediate increase in elevation and severity of the choking after operation in four. In nine cases of abscess of the temporal lobe no involvement of the lids or conjunctivae or evidence of palsy of the extra-ocular muscles occurred. Nystagmus was noted in two cases. Inequality and sluggish reaction of the pupils to light occurred in two instances, with the smaller pupil on the side of the lesion in each. Choking of the disks was noted in five (55.5 per cent) of the nine cases. All the five patients with choked disks were operated on, with subsidence of the choking in four. Homonymous hemianopic fields were found in three cases. In only one of nine cases of abscess of the parietal lobe was there paralysis of the ocular muscles—involvement of both external rectus muscles. Choking of the disks was observed in three patients (42.8 per cent). In three of seven cases of abscess of the parietal lobe there were no ocular signs or symptoms. Nystagmoid movement was found in six of seven cases of cerebellar abscess. Choking of the disks was found in three cases (42.8 per cent), the same degree being present in the two eyes in every case. The average level was 5 diopters. After operation the choking disappeared very slowly. Of four cases of abscess of the occipital lobe, there was continued measurable choking of the disk in three cases, or 75 per cent, and in the fourth case the disk was definitely hyperemic. Two patients had homonymous hemianopia.

One or more ocular signs or symptoms were found in all but six of the forty-four cases of abscess of the brain. However, in only seven cases in the entire series were the defects in the visual field of any localizing value. Choking of the disks was observed in 63.6 per cent of the cases. It is interesting to note that in thirteen the degree of choking remained the same or was even increased after operation.

GRANT, Philadelphia. [ARCH. NEUROL. & PSYCHIAT.]

WORDS AND MASSES—A PICTORIAL CONTRIBUTION TO THE PSYCHOLOGY OF STAMMERING. W. J. SPRING, Psychoanalyt. Quart. **4**:244, 1935.

Spring describes the finger paint production of a boy of 10 who had stammered since the age of 5 years. Both the content of these paintings and the boy's behavior while he made them are important. He came to an art class with a reputation of being irritable and extremely careless with paints. In the new class he at first refused to touch the paint, gave the teacher a false name and made fun of the productions of other pupils. After a while, he secretively began to paint, using more paint than was necessary and being contemptuous of his results. He was openly envious of the skill of other children, continued to criticize their work and often splashed them with water or accidentally bumped their work. After two months of this behavior, during which he worked exclusively with blacks and obviously made no recognizable pictures, he gradually evinced more interest in the teacher and began to paint. His first described painting was in a dark reddish brown and depicted words falling from the mouths of two women in the next room.

For the next two or three weeks, he continued to paint words in black or brown. All words had specific shapes; e. g., "she" was two globes connected by a double line.

At this point he became more confidential with the teacher and told her that the other children did not like him because he smelled. The teacher discussed methods of personal cleanliness with him, and he was much surprised when he learned that she too had to defecate. Shortly after this, he told her that he stuttered because of the shapes of words. Easy words came out easily because they were shaped like sausages and were liquid. Other words stuck and caused him to stammer because they had corners or were square. "Hour" was big and round in the middle and had four little knobs on each end. "Fear" was a line with two knobs on each end. "Home" had many jagged edges. The name of a teacher whom he disliked had many prickles on it, while the name of his painting teacher, whom he liked, was liquid and did not cause him to stammer. As soon as this had been discussed, he ceased painting shapes of words and began to use bright colors, always painting a story represented by streamers emerging from a treelike trunk. He became more friendly with his teacher, and his stammering improved while he was with her, although he continued to stammer badly with persons whom he disliked. Shortly after this, he was withdrawn from the school, and observation of him ceased.

Spring points out that this case gives an unusually vivid illustration of several important dynamic factors in stammering. These are: 1. The unconscious identification of words with feces. 2. The unconscious identification of words with an introjected object. The patient stammered because of the prickles on the name of the teacher whom he disliked; i. e., the conflict between the subject and the object (teacher) was expressed by a conflict between the ego and its speech apparatus and products. 3. The identification of the body with a penis from which emerge exhibitionistic, urethral and anal products.

According to the painting teacher, five or six stammerers have shown improvement. Perhaps the invitation to smear justifiably in painting offered the children a situation well suited to overcome the sense of guilt connected with anal wishes. The teacher, being really interested in the painting, could put a high value on the products of this smearing activity, making them the source of object-directed gratification. By this the fecal mass would become raised to the level of a gift, making possible a partial use of the anal conflict, at least in relation to the teacher.

PEARSON, Philadelphia. [ARCH. NEUROL. & PSYCHIAT.]

CERTAIN REACTIONS OF THE OCULONASAL NERVES. L. HALBRON, Ann. d'ocul. **174**:145 (March) 1937.

The related reactions of the eye and the nose, both physiologic and pathologic, have long been known. Simultaneous stimulation of the organovegetative system of the orbit and that of the nasal fossae causes sensory and vasomotor syndromes which are no more pituitary of ocular origin than orbital of nasal origin. Halbron purposely does not discuss suppurative sinusitis and the orbital complications.

Under the section on the clinical study of oculonasal nervous reactions the author discusses (*a*) the syndrome of the nasal nerve, reporting two cases observed by the authors in which the symptoms of pain, ocular signs and acute rhinitis occurred, and (*b*) the syndrome of the sphenopalatine ganglion, the symptoms of which are pain, and involvement of sympathetic nerves.

Under the section on diagnosis of the syndrome of the nasal nerve and that of the sphenopalatine ganglion he discusses the syndromes and then the clinical diagnosis of the two syndromes in relation to various types of facial neuralgia. The last topic is subdivided into neuralgia of facial nerves, pain in the ophthalmic zone and neuralgia of facial sympathetic nerves.

Treatment of these syndromes often proves their spasmodicity and is therefore of diagnostic value. Local treatment recommended is the introduction of cocaine into the nostril; general treatment consists in soothing the nervous system and attempting to eliminate intoxications or endocrine disturbances.

McKee, Montreal, Canada. [Arch. Ophth.]

Hypertrophy of the Thymus and Sudden Death in an Infant Four Months Old. Paul Giraud, Salmon and Jouve, Bull. Soc. de pédiat. de Paris **33**:724 (Dec.) 1935.

A girl 4 months of age was admitted to the hospital for operation on a bilateral harelip. She had increased substernal dulness to the left and right, which corresponded to a widened mediastinal shadow seen in a roentgenogram of the chest. Operation was postponed. Pharyngitis developed, and she died suddenly. Necropsy confirmed the presence of a large thymus, which weighed 40 Gm.

Benjamin, Montreal, Canada. [Am. J. Dis. Child.]

Physiologic Function of the Orbicularis Palpebrarum Muscle and the Problem of the Superior Portion of the Facial Nerve. E. Velter, Rev. d'oto-neuro-opht. **13**:435 (June) 1935.

The muscles actuating the eyelid may act singly, but more often they participate in associated complex movements that protect the eye, result in winking and assist in movements of mimicry. Global paralysis of the orbicularis muscle produces lagophthalmos, epiphora and eversion of the punctum. Excitation *en masse* causes blepharospasm; certain localized spasms produce spasmodic entropion or ectropion. The orbicularis muscle is innervated by branches of the superior portion of the facial nerve. While it has generally been supposed that only the inferior branch of the facial nerve is involved in facial paralysis accompanying hemiplegia, Déjerine maintained that the superior branch is always involved as well, but to a far less noticeable degree. Physiologic and clinical data show the relative independence of the superior branch of the facial nerve. After discussion of the observations and researches of a number of investigators, Velter concludes that there is no evidence that proves the existence of a separate nucleus in the midbrain or in the cortex for the superior branch of the facial nerve. Autonomy of this branch depends on bilateral corticonuclear connections through a double pathway: the geniculate bundle, on the one hand, and the pathway of aberrant fibers, on the other. There is still much that is not known about the complex nervous mechanism involved in winking. The ophthalmic and optic nerves compose the centripetal leg of the reflex arc. The fibers in the fifth nerve enter the descending root and arrive at the gelatinous substance of Rolando. The centrifugal pathway is formed by the common motor oculi nerve (third nerve) and the facial nerve. A bilateral central innervation is necessary to explain the normal bilaterality of winking and its persistence in cases of isolated paralysis of the third and the seventh nerve.

Dennis, San Diego, Calif. [Arch. Neurol. & Psychiat.]

The Virus of Heine-Medin Disease. Faz Tabio, Arch. de med. inf. **4**:181 (July-Sept.) 1935.

The filtrable virus of poliomyelitis shows peculiar characteristics. It resists drying, extreme cold and even prolonged freezing, but is rapidly destroyed by sunlight. It will remain active a long time if preserved in a 50 per cent solution of glycerin and protected against sunlight.

The disinfectants which destroy it best are mercury bichloride, chlorine, hydrogen peroxide, menthol, phenyl salicylate and boric acid. There seems to be a multiple virus, which possibly explains the various forms of infection.

Domestic animals, flies and mosquitoes do not transmit the disease. It is apparently not carried in milk or other fluids, but the virus will live in such fluids. Transmission is by direct human contact. The nasopharynx is the port of entry. The gastro-intestinal tract does not seem to be a source through which the infection gains entry.

The best prophylaxis against the disease lies in proper care and treatment of the nasopharyngeal tract.

SCHLUTZ, Chicago. [AM. J. DIS. CHILD.]

CONGENITALITY AND HEREDITY OF BRONCHIECTASIS. M. KARTAGENER, Ergebn. d. inn. Med. u. Kinderh. **49**:378, 1935.

On the basis of his observations in 142 cases of bronchiectasis, as well as on that of a study of the literature, Kartagener inclines to the belief that bronchiectasis is a congenital condition, for the following reasons: 1. There is a striking predilection for certain lobes of the lungs (the left lower and the right upper and middle lobes). 2. Pathologico-anatomic investigations of bronchiectasis show absence of elastic fibers in the bronchial wall despite absence of inflammatory processes. This absence of elastic tissue is the histologic expression of the so-called idiopathic bronchiectasia ("default original" of Bard). The so-called acquired bronchiectasis, however, is the result of destructive processes (abscesses or gangrene) within the parenchyma of the lung and thus is not to be classed as true bronchiectasis. 3. One frequently finds other anomalies and areas of malformation of the respiratory system in patients suffering from bronchiectasis. The fact of the multiplicity of malformations, well known in the realm of pathology, is further confirmed by the striking frequency of bronchiectasia in cases of situs inversus viscerum. 4. The occurrence of the condition is familial; this fact has been observed in thirteen families, in four of which twins were involved.

Kartagener concludes with the remark that even if one does not doubt that bronchiectasis may be acquired one must admit as a result of a consideration of the aforementioned reasons that congenital bronchiectasis is of much more frequent occurrence than has hitherto been assumed.

CAPPER, Philadelphia. [AM. J. DIS. CHILD.]

Society Transactions

AMERICAN LARYNGOLOGICAL ASSOCIATION

Fifty-Ninth Annual Congress, Atlantic City, N. J., May 31 and June 1 and 2, 1937

WILLIAM B. CHAMBERLIN, *President*

CHARLES J. IMPERATORI, M.D., *Editor of Abstracts*

ADDRESS BY THE PRESIDENT, DR. WILLIAM B. CHAMBERLIN, Cleveland

In the first part of the address reference is made to the present trends toward state medicine and the growing threat of socialization of the medical profession. The systems of medical practice in foreign countries are cited in comparison and are briefly described, together with their advantages and disadvantages. The opinions expressed are deduced largely from personal communications from correspondents in the various countries as well as from statements in the literature. The list includes the panel system in England and complete socialization in Russia as well as the partial socialization and *Krankenkassen* systems in Germany and Austria. The system in Sweden is also referred to.

Mention is made of the elaborate social service organizations which have developed in most of the larger hospitals and their tendencies if not properly guided. Physicians are urged to give most careful consideration to the present social trends in medicine and to guide them as far as they are able, not only for the sake of the profession itself but more especially for the sake of the public which it is endeavoring to serve.

In the second part of the paper certain trends in surgical procedure are referred to, namely, the enucleation of the tonsils with the use of the angle of the lower jaw as a fulcrum, the external operation on the accessory sinuses of the nose and the direct examination of the larynx and its tendency to supplant entirely the indirect method. The use of injections of milk and of foreign proteins is also referred to, as is the use of insulin in nondiabetic conditions. The statement is made that allergy is as yet largely a working hypothesis and so-called desensitization is still far from accomplishment. Ionization is mentioned to be condemned. Hemilaryngectomy and total laryngectomy have made rapid strides, and mortality has been greatly reduced, largely through the efforts of certain members of the American Laryngological Association.

The last part of the paper deals with a suggested technic for draining an abscess of the brain. After the abscess has been located by means of a brain needle, a new and fairly stiff rubber catheter, slit along one side, is folded over the needle, and a suture is placed in the distal end of the slit to hold it closely together. The catheter is slid along the needle until its distal end lies in the abscess cavity. The needle is then withdrawn, and two proximal ends, another slit opposite the first having been made, are sutured to the dura. This insures the catheter's remaining in position and not being expelled by intracranial pressure. As healing takes place, the catheter is gradually withdrawn.

CYSTS OF THE MANDIBLE. DR. THOMAS E. CARMODY, Denver.

The varieties of cysts are listed. Congenital cysts are described, including dermoids and so-called dentigerous cysts. Cysts following infection are also discussed. Clinical, roentgen and microscopic diagnosis are described. Treatment is always surgical.

DISCUSSION

Dr. Gordon Berry, Worcester, Mass.: May I ask Dr. Carmody to comment on the danger of fracture of the jaw in the treatment of a cyst?

Dr. Harris P. Mosher, Boston: In treating a dentigerous cyst in the hard palate and filling the whole antrum, does Dr. Carmody go through the canine fossa and attempt to dissect it out and pack the canine fossa until he has completed his cure?

Dr. Frank B. Kistner, Portland, Ore.: I should like to ask Dr. Carmody to repeat what he said about the radiosensitivity of adamantinomas.

Dr. William B. Chamberlin, Cleveland: I should like to mention 2 cases of adamantinoma which I recently observed through the courtesy of the surgical department at the Lakeside Hospital. The patients were young Negro women between the ages of 20 and 30. One had all the adamantinoma removed with the exception of the articulation of the lower jaw. Later, there was a recurrence in this articulation, and when the entire articulation was removed there was no recurrence. Both the tumors were enormous masses causing striking external deformities.

Dr. Harris P. Mosher, Boston: Did the articulation of the jaw become fixed?

Dr. William B. Chamberlin, Cleveland: No. There has been satisfactory use of the jaw.

Dr. Thomas E. Carmody, Denver: In answer to Dr. Gordon Berry's question, there is always a possibility of fracture, but in most cases, as in that reported by Dr. Chamberlin, if the periosteum is saved the jaw regenerates in good shape. However, if there is a fracture it should be treated as such.

Dr. Mosher, the cyst was in the mandible and not in the maxilla.

Dr. Kistner, these growths are apparently neither radioresistant nor radiosensitive. It is almost a paradox that neither radium nor roentgen rays seem to have much effect.

Comparative Anatomy of the Tongue. Dr. Gregor McGregor, Toronto, Canada.

In this paper some of the interesting and practical points in the development and anatomy of the tongue are presented. There is marked variation in the structure and adaptation of this organ throughout the mammalian group and also in the lower vertebrates. The manner in which the tongue functions in different animals according to their habits shows many curious and complicated developmental variations. Some discussion of the sublingua and its relation to the tongue is offered.

DISCUSSION

Dr. H. Marshall Taylor, Jacksonville, Fla.: In the study of the comparative anatomy of the tongue, one's attention is also drawn to the adaptations which the animal has for its environment. The posterior margin of the tongue of the alligator is elevated as a transverse fold that meets the velum palati from the lower side and completely shuts off the mouth from the opening of the trachea and the gullet when the animal submerges.

I believe there is another purpose of this modification which Dr. McGregor did not mention, that is, protection of the ciliated epithelium from water, as the alligator always closes the anterior nares when diving. Many of the aquatic birds likewise have an arrangement of the tongue which is somewhat similar to that of the alligator. The booby, the cormorant and the snake bird have no external nostrils and plug their posterior nares with their tongues when diving. This arrangement is doubtless for the purpose of preventing water from coming in contact with the mucous membrane of the respiratory tract.

BENIGN TUMORS OF THE LARYNX. DR. CHEVALIER JACKSON, Philadelphia.

The following is a list of nonmalignant tumors and tumor-like conditions of the larynx encountered in my clinical experience: eversion of the ventricle and prolapse of the sacculus, laryngocele, benign epithelial tumor, papilloma, pachyderma, keratosis or hyperkeratosis, fibroma, edematous fibroma, nodules on the vocal cords, nonspecific granuloma, hematoma, angioma and fibro-angioma, cystoma, teratoma, myoma, myxoma, thyroid tumor, lipoma, adenoma and amyloid tumor. A tentative diagnosis can be made with the aid of a mirror, but confirmation by histologic examination is always sought. Treatment is by direct laryngoscopic removal, great care being exercised to avoid removal of any normal tissue from the base.

DISCUSSION

DR. FRANK ROBERT SPENCER, Boulder, Colo.: One may use the galvanocautery in the treatment of prolapse of the ventricle. The endothermic needle is far superior to the cautery and is under better control.

DR. MERVIN C. MYERSON, New York: I wish that Dr. Jackson would state under what circumstances the accumulation of mucus in the submucosal spaces occurs, or rather the mechanism of the production of the mucus. It is not clear to me.

DR. JOHN H. FOSTER, Houston, Texas: Tumors of the larynx may be divided into benign, premalignant, locally malignant and malignant.

I still believe that primary papillomatosis in children, which either is congenital or occurs in young children and has not been operated on, can in nearly all cases be caused to disappear by the application of roentgen rays. I believe that it is essential that small doses of roentgen rays be given.

DR. WILLIAM B. CHAMBERLIN, Cleveland: I should like to ask Dr. Foster if in any case of exposure to roentgen rays in children, he has been so unfortunate as to observe necrosis of the cartilages.

DR. JOHN H. FOSTER, Houston, Texas: No. There is no reaction to the small doses except a cutaneous reaction.

DR. CHEVALIER JACKSON, Philadelphia: In regard to Dr. Spencer's method of treating that form of cyst, I think it is excellent if Dr. Spencer does it, as the precision of his work is remarkable. If, however, the cautery is used in the same way that a surgeon uses a soldering iron for taking out a cancer of the maxilla, for instance, there is nothing but disaster ahead for the larynx, but in the beautiful, precise way that Dr. Spencer and a number of other members of this association work, I think that the method is ideal.

As to why mucus accumulates under the mucosa, I do not know. I have observed a number of cases in which it occurred. The fluid is clear or slightly flocculent and looks like other cystic accumulations. Histologic preparations were not available for study, nor was the source of the fluid traced.

I quite agree with Dr. Foster about the matter of classification. I also agree with him about the dangers of overdosage in radiation. Certainly overdosage is a disaster, but properly regulated dosage is giving some results and the method should be considered.

LACERATION OF THE THROAT: PRESENTATION OF A PATIENT. DR. GEORGE B. WOOD, Philadelphia.

The patient was an intern in a hospital, and while making rounds he was attacked by an insane patient. He received severe injuries to the great vessels and nerves in the neck. Prompt attention saved his life.

The principal symptoms were recurrent paralysis of the vocal cords and Horner's syndrome on the side injured. He had partially recovered from the paralysis, but Horner's syndrome remained.

ESOPHAGEAL SPEECH FOR ANY LARYNGECTOMIZED PATIENT. RALPH H. STETSON, PH.D., Oberlin, Ohio.

This article was published in full in a previous issue of the ARCHIVES (**26**:132 [Aug.] 1937).

DISCUSSION

DR. LOUIS H. CLERF, Philadelphia: I hoped that Professor Stetson would present patients, and I shall be grateful if he will do so.

I am much interested in Professor Stetson's paper, because he points out that there are such things as refinements of speech for the laryngectomized person, when the majority feel happy if the patient can make some sort of sound that can be interpreted as a spoken word.

The artificial larynx has contributed something, but at best it is a makeshift, depending on humidity and other factors.

(Two patients demonstrated their ability to use the esophageal voice.)

DR. GORDON B. NEW, Rochester, Minn.: I think one cannot help being greatly impressed with the wonderful results Dr. Stetson has shown. All physicians who do laryngectomies have a group of patients who talk similarly to these patients. There are certain patients who can talk well even without training. I have sent other patients to them, feeling that they ought to be able to tell other patients just how they should talk, but the success has not been as great as that of Dr. Stetson. Unfortunately, I have had to resort to the artificial larynx for some of my patients, owing to the fact that with all the instruction that could be given, they could not talk.

DR. RALPH H. STETSON, Oberlin, Ohio: One can improve the artificial larynx, though I should rather not have a patient try it until he has worked for two or three months on the normal esophageal form of speech. The suggestion I have for the artificial larynx is to use a silver mouth tube, flattened at the end and curved slightly toward the center line of the palate. The end should be between the velum and the hard palate. It gives more accurate and clearer enunciation. Many patients will stumble onto good esophageal speech. Any one who has the patience can be trained to use the esophageal voice by covering the cannula when he first tries the intake. The patient should use the fingers on either side of the cannula, and he will certainly get a tone when he has a little air in the upper part of the esophagus. With that as a start and a series of graduated exercises, he will acquire an esophageal voice.

CELLULITIS OF THE NECK REQUIRING TRACHEOTOMY. DR. GORDON B. NEW, Rochester, Minn.

Cellulitis of the neck does not, as a rule, produce sufficient obstruction of the upper respiratory tract to require tracheotomy. This paper consists of reports of cases in which this was necessary. Many persons with cellulitis of the neck show some edema of the pharynx and larynx, and drainage of the phlegmon causes the edema to subside. When the edema is progressive, however, and the patient is unable to control the mucus, early tracheotomy is advisable. In the group of cases reported, tracheotomy did not increase the seriousness of the infection.

DISCUSSION

DR. WILLIAM B. CHAMBERLIN, Cleveland: Dr. Jackson has emphasized repeatedly the point which Dr. New has made in regard to obstruction following bronchoscopy, especially in children, and the necessity for early tracheotomy before the child is thoroughly exhausted from its efforts at breathing.

DR. CHARLES J. IMPERATORI, New York: In the past year I have observed 2 cases of acute parotitis following urologic operation, in one of which prompt irradiation was followed by recovery; the other patient was also treated by radiation and tracheotomy, but died. I agree entirely with the method of localization of these abscesses. Feeding these patients and giving them water so that they do not become dehydrated is of great importance.

I observed a nurse with cellulitis of the neck who had marked edema of the glottis. Tracheotomy became necessary. She recovered.

Dr. Henry M. Goodyear, Cincinnati: Dr. New spoke of using roentgen treatment on these patients. I wonder if he would tell more about the dosage. I was under the impression that if roentgen rays were used and the dose happened to be more than the patient could tolerate well, it would undoubtedly produce edema of the larynx. I wish Dr. New would also state whether or not he uses roentgen rays for erysipelatous cellulitis.

Some six weeks ago I saw a young woman who had acute tonsillitis caused by a hemolytic streptococcus. She acquired a peritonsillar abscess. I opened the abscess but got little pus. At the same time considerable cellulitis of the neck was developing. The patient had a temperature of 103 to 105 F. and a white blood cell count of 27,000, and it looked as though the situation was going to be serious. She received the usual doses of sulfanilamide and promptly recovered.

Dr. Thomas E. Carmody, Denver: Many of the patients I have observed when they required tracheotomy were already so toxic that the tracheotomy and even opening the abscesses did them no good. Heat applied internally as well as externally should be tried. In practically all the cases pus will be found early. If pus is not found, it is because one has not made the incision in the right place.

I think the point of keeping the patient from being dehydrated is important.

In the cases of parotitis following operations on the abdominal viscera, I think that one has to be cautious and to guard against gravitation of the pus into the tissues of the neck. The roentgenogram is valuable in these cases.

In many cases I do not have to do a tracheotomy because I open the abscess and that is sufficient. Dr. New speaks of one thing that has been troublesome to me, and that is the displacement of the trachea. That has occurred in 1 case of thyroiditis and 2 cases of carcinoma of the thyroid gland in which I have had to do a tracheotomy, and it is difficult sometimes to find the trachea.

Dr. Gordon B. New, Rochester, Minn.: The large majority of patients do not need a tracheotomy, and I should not urge it at all. There were only 5 cases in ten years in which my associates or I had to open the trachea. I like a large hot dressing up both sides of the neck and down the chest.

As to the use of roentgen rays, the erysipelatous infections are the ones in which they help if used early. About the dose of the rays I cannot say. I feel that for parotitic conditions and instances of boardlike swelling roentgen therapy is of great value.

Prognosis in Laryngeal Tuberculosis. Dr. Joseph B. Greene, Asheville, N. C.

This paper was published in full in a previous issue of the Archives (**26**:18 [July] 1937).

DISCUSSION

Dr. Burt R. Shurly, Detroit: The prognosis of tuberculosis has improved from year to year. Some years ago several sanatoriums were established in Detroit, and in these the number of persons with laryngeal tuberculosis has varied from 11 to 17 per cent of those with pulmonary tuberculosis.

In the earlier days the best treatment was lactic acid or a 4 per cent dilution of solution of formaldehyde U. S. P. applied to the larynx. Roentgen therapy was also used. The statistics show that forty years ago 1 person in 7 died of tuberculosis. Tuberculosis took first place in the mortality tables. It is now seventh.

Michigan has a law stating that every one, poor or rich, infected with tuberculosis must be hospitalized. If he is unable to pay for his accommodations, the state takes on the work, and so the prognosis is changed.

Great care and study should be given before any patient with active tuberculosis is subjected to ether narcosis, with the possibility of hemorrhage and lowering of the resistance, and the various operative procedures, for instance, tonsillectomy, that may stir up added infection in the respiratory tract.

It is true that the modern procedure of crushing and cutting the phrenic nerve, artificial pneumothorax and putting the chest at rest are indeed splendid therapeutic measures. Thoracoplasty should be done only when it is absolutely necessary.

It must always be remembered that when there is a laryngeal lesion, one may be certain of finding tuberculosis in the lung or in some other place in the body.

Dr. F. R. Spencer, Boulder, Colo.: The prognosis in laryngeal tuberculosis depends on several factors. 1. The duration and extent of the pulmonary disease is determined by the physical examination and the roentgen rays. This, of course, must include urinalysis, examination of sputum, etc. Few patients acquire laryngeal tuberculosis until the disease has been present in the lungs for several years and has involved more than the apexes. In other words, the laryngeal involvement is a late symptom of pulmonary tuberculosis. 2. The patient's general health and resistance are important. For instance, gastric ulcer, nephritis, diabetes, endocarditis, secondary anemia, etc., materially lessen the chances for recovery. 3. The extent and location of the laryngeal infection is important. Infiltration of the interarytenoid sulcus may exist for months and do no harm. Ulceration, especially a deep ulcer, perichrondritis, chondritis or necrosis often means an early fatal termination.

Patients who are apparently doing well and who give promise of acquiring an arrest of the laryngopulmonary tuberculosis may suddenly acquire marked sensitivity to the toxins produced by the tubercle bacillus and die. Artificial pneumothorax has been the greatest therapeutic advance in recent years and has done much to prevent the laryngeal disease. Dworetzky has shown how much the larynx improves after pneumothorax and how infrequently the larynx becomes tuberculous when artificial pneumothorax is used consistently.

Pregnant women do badly when the larynx is tuberculous. Therapeutic abortion may prevent a fatal termination, which usually comes at the seventh or eighth month otherwise.

Tuberculosis claims 100,000 lives annually in the United States. There are 750,000 cases of open, active disease. Even though the death rate has been reduced 64 per cent since 1900, physicians must further reduce this rate.

Dr. Edward A. Looper, Baltimore: In my experience the prognosis of laryngeal tuberculosis depends on several things. First and most important is early recognition of the disease. The diagnosis of laryngeal tuberculosis is not at all difficult, but it is surprising how many patients are neglected until obstructive changes have occurred. Much of this is evidently due to some of the older teachings and to waiting for the classic symptoms—hoarseness, dysphagia, pain and cough—to develop.

For the past few years strenuous effort has been made to impress on physicians the importance of having every larynx examined at the time the pulmonary lesion is discovered. If this is done, early involvement can be diagnosed in many cases.

The nature of the lesion also has a great deal to do with the prognosis of the disease. An early, simple tubercle which is not broken down can be definitely cured in one or two cauterizations. If the lesion is neglected until there are multiple changes and secondary infection, the treatment and prognosis, of course, are more difficult.

The general condition of the patient, naturally, has a great deal to do with the prognosis of the disease. The larynx will not heal unless the patient has sufficient resistance to overcome some of his general infection.

Proper treatment has much to do with the prognosis. It is certainly better, whenever possible, to treat the patient in a sanatorium. He should be kept at rest.

At the Maryland State Sanatorium my associates and I have found that the number of cases of laryngeal tuberculosis has been reduced 25 per cent within the past five years. We feel that this is due to better education of the public

regarding the importance of looking for the early lesions, to the influence of surgical therapy, pneumothorax, which frequently eliminates the sputum, and to thoracoplasty in some cases. We feel that the judicious use of the cautery is certainly the best method of treatment and that the prognosis is good in all except the extreme cases.

DR. GEORGE B. WOOD, Philadelphia: I want to reiterate what the discussers of Dr. Greene's paper have said: Tonsillectomy in a person affected with active pulmonary tuberculosis is dangerous.

In my belief, the use of the electric cautery is never contraindicated except when the patient has practically no resistance—not enough to heal the wound made by the cauterization. The advantage of cauterization over all types of operation is that it produces an irritative lesion. Experimentally, one can see new blood vessels running through the avascular tubercle that were not there before the cauterization took place. Nutriment is being brought to the diseased area. That is why the cautery does good, and the more reaction one produces by the cauterization, within reason, the better chance the patient has of healing his own tubercle.

DR. MERVIN C. MYERSON, Brooklyn: I have come to feel that about 40 per cent of the patients with tuberculous laryngitis require no treatment. They can be left alone, and the lesions will come to a healed or a latent state. Of the remaining 60 per cent, I should say that half should not be cauterized; that half constitues two main groups of cases: (1) those in which the prognosis invariably is unfavorable, in which ulceration is present which has all the characteristics of a disintegrating lesion and cannot be helped in any way, and (2) those in which there is edematous infiltration with superimposed degeneration, which I think is a secondary infection; when the tubercles are cauterized, a disintegrating lesion is created. In the other 30 per cent of cases, the lesion is amenable to cauterization, and in the superficially ulcerated lesions the ulcerations are rather indolent and one must be careful not to cauterize too deeply.

A METHOD OF CLOSING A PHARYNGEAL FISTULA FOLLOWING LARYNGECTOMY. DR. CHARLES J. IMPERATORI, New York.

This paper was published in full in a previous issue of the ARCHIVES (**26**:179 [Aug.] 1937).

DISCUSSION

DR. JOSEPH C. BECK, Chicago: The fact that Dr. Imperatori closed this fistula is evidence that his is a good procedure. He calls attention to the fact that preoperative irradiation will damage the skin, and that, of course, is shown in his sections. However, I do not believe that the majority of radiologists would be willing to admit that such changes do occur with their method of treatment and the proper filtration that they employ, and one does not see marked destruction and formation of fistulas, as one did in former years. Especially is it true when radium is used. There is a marked difference between the action of radium on the epithelium—I mean distant irradiation with radium in the larger doses——and that of the roentgen rays. It is much easier to filter that layer of the skin that way.

The method of making sliding flaps as it is done in this procedure is not easy, and the closure does not hold as well as that in the pedicle method which I have employed in preference to any other. I use a pedicle flap from the back of the neck, swing it over, unite it in three fourths of the area and then cut the pedicle and adapt it to the closing of the fistula. One takes along with the pedicle a great deal more tissue, one can take along the muscle, if one wishes, and it makes a much easier way of closing the fistula.

I am glad it was mentioned that it is necessary to prevent swallowing as much as possible during the healing of these wounds.

The use of the feeding tube and suction for the removal of saliva and secretions is of great value.

I think that the number of postoperative fistulas is much less now than it was in former times, when roentgen rays were being used improperly.

Dr. Fletcher D. Woodward, Charlottesville, Va.: I have found it a useful procedure to anticipate a fistula and at the time I close the incision, which is made in the midline, I suture a catheter at the upper angle into the pharynx; it is left for about ten days, and the wound is closed in the usual manner. I have found that the advantage of the procedure is that it takes the secretions of the pharynx away from the site of the healing wound.

Dr. Gordon B. New, Rochester, Minn.: Of the two types of fistula, the postradiation type is present in but a small percentage of the cases; the other is the small fistula above the opening in the trachea following a laryngectomy. This later fistula is due to the fact that there is a large opening in the pharynx and a small opening just above the trachea where the secretion will run down from the pharynx. To care for that, all that is necessary is to split the anterior pharyngeal wall under suspension laryngoscopy. If one does this, the fluids will go down into the esophagus in the normal manner.

Dr. Charles J. Imperatori, New York: What I wanted to present was not the ordinary type of fistula, that is, the one resulting from a laryngectomy, because I have been fortunate recently in not having any. It is only for those fistulas in which extensive radiation therapy has been used and in which the skin has undergone the changes shown, that this method of procedure is intended.

Motion Pictures of the Larynx. Dr. F. E. Lejeune, New Orleans, and Dr. J. J. Pressman, Los Angeles.

The Casselberry Prize was awarded by the American Laryngological Association last year for these pictures.

Osteomyelitis of the Skull: Comparison of Two Cases Observed Seventeen and Fourteen Years Ago with Two Observed in the Past Two Years. Dr. Frederick T. Hill, Waterville, Maine.

This paper was published in full in a previous issue of the Archives (**26**:9 [July] 1937).

Cholesteatoma of the Frontal Sinus. Dr. George M. Coates, Philadelphia.

This paper was published in full in a previous issue of the Archives (**26**:29 [July] 1937).

DISCUSSION

Dr. Harris P. Mosher, Boston: There are two main points which I feel are of importance. These are the frequency, position and size of the diploetic veins in the frontal bone and the extent of the infection in the specimens from the frontal bone, the examination of which I have just completed.

Diploetic veins are practically constant in the frontal bone. When compared with the thickness of the frontal bone, the veins are enormous. They are half the width of the bone in the specimen which I am describing. In this specimen the infection spread by way of the veins, especially by way of a double vein at the outer angle of the left frontal sinus. The specimen shows that the infection followed the veins to the surface of the bone, reaching both the periosteum and the dura. About twice as many leads were found to the periosteum as to the dura. A thick, infected blood clot covered the dural surface of the specimen. Two or three leads were found from the bone marrow to this clot. The veins of the periosteum were greatly dilated and often infected. Frothy edema of the periosteum was present over the anterior wall of the frontal sinus. This is probably responsible for the characteristic doughy feeling of the edema. This led physicians to call the swelling "Pott's puffy tumor."

It is a comfort to find the extent of the spread of the infection in this case. It led to the upper edge of the large specimen of bone. Here it was diminished, and nature was able to take care of it from this point on. (The specimen measured 4⅛ by 3 inches [10.5 by 7.5 cm.].) I have been accused of taking away an unnecessary amount of bone. The examination of the operative specimens, especially the examination of the present one, convinces me that I am not taking away a needless amount.

It is the old problem in these cases of how soon to help nature and how much. The new hematologic studies of immunity tend a little to hold one's hands, but they have not yet displaced surgical intervention. They are a great comfort to those given over to much theorizing and to those of a halting nature.

Dr. F. R. Spencer, Boulder, Colo.: In 1930 I reported before the American Laryngological, Rhinological and Otological Society a case of cholesteatoma of the right frontal, maxillary and ethmoid sinuses. This was a primary cholesteatoma, I believe. Primary cholesteatoma is supposed to be congenital and secondary cholesteatoma acquired. There was every reason to believe from this man's history that he had had the growth from birth, because of some prominence of the right eyeball.

I reviewed the literature at that time, and when I talked with Dr. Coates yesterday he said that he had not found many cases reported in the literature. Wolfe had reported a rather larger series in the German literature when I reviewed it in 1930. He classified a few of the growths as secondary and most as primary. I do not agree with this. I believe that cholesteatoma of the sinuses, like cholesteatoma of the middle ear and mastoid, is secondary or acquired and is not a congenital defect.

A case report was given of a cholesteatoma of the sinuses that ten years later became a squamous cell carcinoma.

Dr. Charles Terrell Porter, Boston: The work that has been done under the supervision of Dr. Mosher has been mostly of the radical variety and has been successful for the most part. The edema in osteomyelitis of the skull is a pocky, pitting edema, without particular tenderness, and it differs considerably from that associated with osteomyelitis of the long bones, in which the tenderness is marked. It is also different from the edema of the acutely infected frontal bone in that it is not inflammatory and is not tender. The edema of osteomyelitis of the frontal bone is induced by the blocking of the venous channels in the bone. Until more intelligent and more exact laboratory work is done, I think the only safe plan is to operate immediately and extensively.

Dr. Harold I. Lillie, Rochester, Minn.: Osteomyelitis of the frontal bone is a serious disease, and, as has been inferred, it may require heroic measures. I should like to relate an experience I recently had. A fine looking young girl came to the hospital with a diffused mass over the middle portion of the frontal area that had been present for a month and followed scarlet fever. Roentgen and clinical examinations were made to determine her general physical condition, and it was decided that a radical external operation would be necessary; however, the day before she was to enter the hospital, she contracted a severe infection of the upper respiratory tract which delayed any surgical intervention. Much to my surprise, the next week this mass disappeared both clinically and from the roentgen standpoint. What appeared to be a sequestration of the outer table was found to be gone when new roentgenograms were taken; the mass had disappeared, and the young lady was well. She was requested to return in a month. She had no symptoms other than the local manifestations, and to my satisfaction remained well. The infection of the respiratory tract saved her from radical external operation on the frontal sinus.

Nature apparently has a great tendency to repair diseased parts. I think one should respect this. That is what the physician is doing when he removes large infected areas of bone to the limit of the diseased area. He is doing for nature what she is trying desperately to do.

In 1925, under the heading "Some Unusual Conditions of the Frontal Sinus," I reported a case in which the condition was similar, except that the cholesteatoma filling the frontal sinus had resulted from a draining orbital fistula which had been used to drain an orbital abscess some years previously.

DR. FLETCHER D. WOODWARD, Charlottesville, Va.: I have seen Dr. Coates' patient, and it seemed to me that the lesion was a typical cholesteatoma. The pathologists felt that one could not attribute it to any outside communication and that it must have been due to a fetal rest of epithelium or to metaplasia of epithelium, and he was inclined to think it was a type of cholesteatoma.

Twelve years ago I had 3 patients with osteomyelitis of the skull in the hospital at one time; in all 3 the process was due to a rupture of the frontal sinus into the orbit and spreading osteomyelitis. Two of the patients acquired abscess of the brain. Fortunately, after many months of struggle, they all recovered.

When I observe a case of staphylococcic infection, which is the frequent cause of osteomyelitis, I immediately test the patient's serum to determine his resistance to staphylococci as expressed by the titer, and in nearly every case it is low. I also know from experience that by giving a staphylococcus toxoid I can raise the resistance tremendously in a short time. Since I have instituted prompt treatment with toxoid, blood transfusions and staphylococcus antitoxic serum, my patients have not acquired osteomyelitis.

DR. JOSEPH C. BECK, Chicago: The varying degrees of inflammation in osteomyelitis can be followed in the course of the retrograde thrombosis. The bactericidal action of the bone marrow is well recognized.

DR. THOMAS E. CARMODY, Denver: I have been unfortunate in seeing many patients with osteomyelitis; unfortunately, a number of them died, and I am not so sure about the advisability of the radical operation in some cases.

I observed a case similar to Dr. Lillie's in a boy of 8 years. He had a great deal of swelling of his forehead, and roentgenograms showed an area of inflammation about 3 cm. above the frontal sinus. I watched this, and the swelling disappeared; several months later what looked like a sequestrum was included in the frontal bone, and healing took place. I kept track of him for about a year and a half. He has had no recurrence. This was several years ago. There is a possibility, in my opinion, that there may be a cutting off of the air in these cases. Possibly aerobic bacteria were the cause of the infection, and when air did not enter the sinuses the growth was inhibited.

Another thing that has been brought out by Dr. Mosher is the fact that in roentgenograms of the flat bones, one does not find evidence of inflammatory changes until eight or ten days after the process has started. That is something that one must keep in mind. One has to rely on one's clinical judgment. I think that some patients with osteomyelitis will get well without operation.

DR. GREGOR MCGREGOR, Toronto, Canada: Dr. Coates mentioned trauma as a causative factor in the formation of cholesteatomas. In connection with that factor one must consider reinfection damaging the mucous membrane. A process of metaplasia may thus begin, changing the columnar epithelium to stratified epithelium and from that to the cholesteatomatous formation; however, there must be some other factor, perhaps the exclusion or partial exclusion of air. The process is commonly observed in cysts in the sinus, in which the epithelial lining of the cyst is changed to a flattened type of epithelium and collections of cholesterol either in solution or in crystalline form, are fairly common. The combination of the change in the epithelium and the exclusion of air or some other interference with the function of that particular part produces the cholesteatoma.

Every injury that becomes infected or damaged does not go on to the formation of cholesteatoma, but some of the patients are found to have a high cholesterol content in the blood, so that I think infection must be considered when trauma is a factor.

Dr. Lyman G. Richards, Boston: I should like to add just one more experience on what might be termed the conservative side in the hope that Dr. Mosher, in closing the discussion, will elucidate the matter of edema a little more.

The son of a close friend of mine, who acquired a typical orbital abscess, was operated on in the classic manner on my advice after the infection was allowed to subside; the external approach was used, and the infected cells were removed. The wound completely healed, but some nine months afterward typical circumscribed edema developed over the frontal bone. My associates and I were confronted with a problem as to whether or not he had osteomyelitis of the frontal bone. The problem as to whether or not he should be operated on in a radical fashion had to be considered. There was much discussion as to whether or not we should subject this boy to what seemed to be the proper procedure—the external operation—and we finally decided against this.

The original curvilinear scar of the tissue was opened. No pus was found, and the infection, as Dr. Lillie and Dr. Carmody mentioned in their case reports, had all subsided. This was five or six years ago. He is entirely well.

Dr. John MacKenzie Brown, Los Angeles: About a year ago, Dr. Tholen, an oral surgeon, asked me to look at an antrum he had just opened. On examination I found a tumor mass the size of a pigeon's egg, which was pearly white and looked much like the cholesteatoma that is found in the ear. Dr. Tholen removed this. It was attached to the floor of the antrum, and when it was cut open, there was no odor. The tumor was discovered accidentally by roentgen examination of the patient, and the patient was referred to Dr. Tholen on account of arthritis. The antrum was perfectly normal in appearance, and the young man had never had any symptoms referable to the nose.

Dr. George M. Coates, Philadelphia: Osteomyelitis is of the utmost interest, and I should like to say a few words about my experience with it. My early patients were all treated conservatively, and so far as I recollect they all died, while the later patients, who were treated radically, all got well.

It was my fortune, good or bad, to have 3 of these patients about the wards of the hospital at the same time, four years ago, 2 with acquired infection of the frontal sinus. In 1 case the process followed chronic suppuration of the middle ear. In all these cases from a quarter to half of the upper part of the skull was removed and the deformity was great. In 1 case there was complicating abscess of the frontal lobe. In 2 cases there was regeneration of bone. In the patient with the abscess of the frontal lobe in three or four years no appreciable regeneration of bone has been shown in the roentgenogram or by palpation.

In all these cases, in my experience, the infecting organism has been Staphylococcus aureus. I have not observed any case in which the infection could be attributed to a pneumococcus or a streptococcus, but I feel strongly, as Dr. Woodward feels, that if physicians can get some help from antitoxin or from a staphylococcus toxoid, they may have more success in dealing with these cases.

Reliance in the past, in my case at least, has been on repeated transfusion of blood. As to the question of removing large portions of the skull in these cases, which some, at least, believe to be the safest procedure, one would be much more likely to resort to radical removal of the bone at an early stage if one could be sure that there would be regeneration of bone, but apparently regeneration of bone does not always take place.

I have been told (by whom I do not know) that if bone dust is put in the wound or gets into the wound from trephining or removal of portions of the skull, regeneration of bone is much more likely to take place, and I expect in the next case I have to try putting back either chips of bone or bone dust to see if that has any influence on the regeneration of bone.

Dr. Harris P. Mosher, Boston: For the present, I prefer to operate first and to use biochemical means to help nature combat what is left of the infection, because I do not believe that, even in the most radical type of operation, one gets entirely beyond the infection.

There are two kinds of osteomyelitis, and how is one to tell them apart? How is one to tell whether the bone will sequestrate? My feeling is: If there is acute frontal sinusitis following swimming or caused by driving with the windshield up, it is fulminating and demands immediate operation. If there is edema that starts in the frontal sinus, continues to the hair line and does not localize, my opinion is that this condition demands an extensive operation on the bone.

As to the deformity, there is marked deformity at first, but a plastic operation will correct this to a great degree. The bone dust could be put in at the time of the plastic operation.

SPONTANEOUS PERFORATION OF THE WALL OF THE CHEST BY AN ASPIRATED FOREIGN BODY. DR. E. M. SEYDELL, Wichita, Kan.

This paper was published in full in a previous issue of the ARCHIVES (**26**:189 [AUG.] 1937).

DISCUSSION

DR. H. MARSHALL TAYLOR, Jacksonville, Fla.: I have never known of a case in which a sand spur perforated the lateral wall of the chest. I do not believe that the sand spur has the power of propulsion which is peculiar to the head of wheat. I did see one patient who had a pulmonary abscess after inhalation of a sand spur. I saw the patient only when he was moribund, at which time he had subcutaneous emphysema of the neck, intercostal spaces, abdominal wall and scrotum.

DR. JOHN H. FOSTER, Houston, Texas: The head of wheat Dr. Seydell displayed has sharp barbs, and when they get into the tissues, they tend to work through. There are a number of other grasses and leaves which have these same barbs, and they invariably have this faculty of working through.

I remember that many years ago a patient came to me, stating that he had a pine needle in his throat, and he located it at about his left tonsil. I could not locate it or find it, and within a week he came back with a swelling in his neck, and the pine needle was drawn out through an incision in the skin.

Just to add to the record that Dr. Seydell has made of cases similar to this, I should like to say that a few weeks ago one of my associates, Dr. Codey, had a patient brought to him by a general surgeon from a city about 150 miles (241 kilometers) away, with the history of having two or three days previously inspired a head of millet grass. It is similar to domestic millet but much smaller. The patient, on roentgen examination and auscultation, showed considerable inflammation of the base of the right lung. They passed a bronchoscope and found nothing in the bronchi which they could enter with the bronchoscope.

A day or two later the patient expectorated a good deal of blood. I saw him, and Dr. Codey and I again searched as carefully as we could with a bronchoscope and found nothing, except that we could see where the blood was coming from. The patient was allowed to go home, and in a week the general surgeon reported that he had made an incision in the side and drawn the millet out. The patient made an uneventful recovery.

DR. LYMAN G. RICHARDS, Boston: It is rather extraordinary that all the vegetable foreign bodies Dr. Seydell has grouped as perforating were of the nature of grass. One would think that grass would be less harmful than something like a pine needle.

This brings to my mind rather forcibly a somewhat similar case, in which owing to surgical intervention, the foreign body did not get so far; judging by what Dr. Seydell says, it would have done so. A child of 4 years aspirated a piece of grass which I tried unsuccessfully twice to find with the bronchoscope. This patient acquired a pulmonary abscess, which was drained externally, and the foreign body was subsequently coughed up.

The problem of finding vegetable foreign bodies bronchoscopically is difficult. They are not opaque to the roentgen rays, they work their way into the smaller

terminal bronchi, where it is practically impossible bronchoscopically to find them and they are prone to cause pulmonary suppuration. It is an interesting commentary on this type of foreign body, which one would think ordinarily was of a relatively innocuous type.

Dr. Louis H. Clerf, Philadelphia: The grasses in the collection of foreign bodies at the Jefferson Medical College of Philadelphia form a rather small group. I dare say that timothy heads constitute the largest number. There must be ten or twelve of those, and they were all removed bronchoscopically, but a timothy head has a sharp barb on it. These long-barbed objects move more rapidly. Obliteration of the pleural space so that the continuity is uninterrupted permits a rapid penetration of the wall of the chest.

With regard to the sand spurs, I recall but one in this group that was in the bronchus. The others were higher up. It was associated with a pyopneumothorax.

Dr. Charles J. Imperatori, New York: Dr. Seydell's reports were on foreign bodies introduced into the bronchi and making their exit through the wall of the chest. I should like to report a case in which a foreign body was introduced into the wall of the chest and made its exit in the bronchus.

I have a patient on whom a thoracotomy was done for empyema. A gauze drain was placed in the cavity and in some way was lost. Three years afterward it was removed from the main bronchus.

The man had pleurisy developing into empyema and had a thoracotomy done in 1922. From 1922 to 1924 he had a more or less continuous mucopurulent expectoration. In 1922 the fistula in his chest opened and a piece of a wooden applicator was removed. In 1923 a piece of gauze was removed from this fistula. Eventually he came to the New York Post-Graduate Hospital, complaining of expectoration of pus and the occasional expectoration of a piece of thread. The roentgenographer made a diagnosis of a possible foreign body in the lower left bronchial area.

On bronchoscopy a small projecting body was seen in the wall of the left bronchus, and a piece of gauze packing, 8 inches (20 cm.) in length was removed. This foreign body had remained in the pleural cavity for two years. It then penetrated the pulmonary tissues, and one end of it appeared in the main bronchus.

The patient made a good recovery and has remained well since the removal of the foreign body.

Analysis of the Results of Vaccination of College Students Against Colds. Dr. Karl M. Houser, Philadelphia.

This article was published in full in a previous issue of the Archives (**26**:283 [Sept.] 1937).

DISCUSSION

Dr. Thomas Roy Gittins, Sioux City, Iowa: I should like to ask if Dr. Houser has had any experience with vaccines for oral administration and what he thinks about them and their theoretical value.

Dr. Burt R. Shurly, Detroit: The whole problem, it seems to me, is wrapped up in the resistance of the patient. I have gone on for about twenty years with but one cold, I think. I always thought that perhaps I was immunized by many patients who had colds and that I was partially vaccinated from day to day. Whether or not that theory is correct, I shall never be able to prove. There is an idea, which has been prevalent for years, that if one has the tonsils and adenoids removed one will have fewer colds. This is only partly true.

Of course, there is the problem of resistance as related to vitamin A. One drop of halibut liver oil is equivalent to 3 teaspoonfuls (11 cc.) of cod liver oil. There is no question that in experimentation with animals the bacteria will fade away and that corneal ulceration, infection of the respiratory tract, ulceration of the tongue, sinus infections and running of the ears which the white rats have

acquired and the formation of calculi which occurs with a deficiency of vitamin A will disappear; yet in the human being these things do not work out the same way.

If one can raise the resistance of the patient and have him use his common sense in the proper protection of his body and do away with excessive artificial heating in the home, there will be far fewer colds.

DR. GEORGE M. COATES, Philadelphia: While the series is small, it has significance because of the fact that the subjects are not the ordinary run of persons who might come into the student health service but have a definite history of having had repeated colds for a good many years, and I think from the figures Dr. Houser shows of the decided diminution both in the number and in the severity of the colds, as shown in the reduction of the number of days lost, one can conclude that this method has some probable or possible merit.

If a cold is due to a virus infection, I cannot see that the administration of vaccines will prevent it, but if the cold is produced by virus infection and continued by infection from pus-producing microbes in the nose, it seems to me that the prophylactic use of vaccines may limit it to its probable course of only two or three days.

It has been my experience in a few cases to find that the patient was made more susceptible by the use of prophylactic vaccination, and some few persons seem positively to be more prone to colds than they were before.

I think that what Dr. Shurly said about the removal of tonsils and adenoids is true. I think that it does limit, to a degree, the number of colds the patient is likely to have. There are a few persons who seem to be more susceptible to colds after the elimination of these foci of infection.

DR. HOWARD C. BALLENGER, Chicago: I think the work of Dochez and his co-workers has shown that the virus of colds may be transmitted and propagated in the ordinary vaccines that are grown commercially, and one may be treating the exact cause of the cold when one is using the stock vaccine. I should like to ask Dr. Houser whether he thinks he could attain this 1 cc. maximum dose in less than eight or ten injections; in other words, could he do it in three or possibly four?

DR. JAMES A. BABBITT, Philadelphia: I have been much impressed with the correlation of certain types of allergy. In sending these persons to be tested, I have been surprised at the number who were reported as sensitive only to house dust. I want to put one query to Dr. Houser: Would it be worth while to investigate the possibilities of reaction to house dust in certain types of patients, and would it be worth while in conditions suggesting allergy which is not definite and not seasonal to undertake desensitization with certain stock house dust vaccines?

DR. WILLIAM B. CHAMBERLAIN, Cleveland: Although it may not be pertinent and nothing has been said about local treatment, many physicians as well as patients are addicted to local treatment for colds, and one can only recall in this connection the famous dictum of Morris Schmidt: A cold if treated lasts for two weeks; if untreated, it lasts for fourteen days.

DR. KARL M. HOUSER, Philadelphia: With regard to Dr. Gittin's question about vaccine for oral administration, I know nothing about this type of vaccine.

In this group of persons my associates and I paid little attention to tonsils and adenoids unless we could demonstrate a pathologic condition or unless the patient was susceptible to colds of the type in which the cold is always preceded by mild tonsillitis or pharyngitis; then we felt that possibly the tonsil was at fault. I cannot give any accurate figures on just how many have retained their tonsils.

There is one thing of significance, and that is dosage. In most of the large series reported in which failures are recorded, three or four doses have been used, instead of a long series of graduated doses. I think the point that Dr. Coates makes of the carrying out of the treatment throughout the winter months is a good one.

That, I think, answers Dr. Ballenger's question with regard to arriving at the full 1 cc. dose in three or four doses. I think it can be done with reasonable safety and little chance of doing harm to the patient or causing any troublesome symptoms, but I question if it is worth doing as quickly as that.

Every patient who came under our scrutiny who had any symptoms at all suggestive of allergic phenomena was tested. If his condition was purely allergic, he was not included in this group; if it was allergic with a coincident infection, he was included, provided the allergic condition was taken care of as well as the infection.

RELATION OF CLINICAL CONDITIONS OF THE UPPER RESPIRATORY TRACT TO OXYGEN METABOLISM. DR. D. C. JARVIS, Barre, Vt.

The central problem in medicine is one of oxygen metabolism instead of one of infection. The cells of the body are built and rebuilt by means of the oxygen in the air and the minerals from the soil which are transferred to the body by products of the soil which have transferred these minerals to their own composition.

The biochemical composition of the body is considered. The catalytic action of small doses of thyroid, iodine, insulin or dilute hydrochloride acid as oxidizing catalysts, or activators, is described.

The influence of oxidizing catalysts on the common cold, the size of the turbinates, paranasal sinusitis, atrophic rhinitis and acute and subacute laryngitis is described.

DISCUSSION

DR. ALLISON T. WANAMAKER, Seattle: I feel that some of the things that Dr. Jarvis has accomplished are worth while; other things I cannot follow. For instance, he spoke about the treatment of cancer with insulin. I have under treatment a woman on whom I performed a radical mastoidectomy. After several months the wound has not healed. She is diabetic and takes about 25 units of insulin per day. The other day, in examining some of the recurrent granulation tissue, I found that it was cancerous. This woman was getting insulin long before she had a mastoidectomy, and in spite of the insulin, the cancer developed.

I have tried dilute hydrochloric acid on some of my patients to see what effect it would have on the nose. I have not been doing it long, but I do know that it helps. It brings about a change in the color and a reduction in the swelling of the mucous membrane.

Some Arctic explorers have noted that when they suffered from cold the taking of vinegar relieved them a great deal, and one man gave it to his associates in his expedition. I do not know where they got the idea, but vinegar seems to act a good deal like hydrochloric acid, and it may be that it is similar in its action.

DR. D. C. JARVIS, Barre, Vt.: Insulin helped the cancer so far as it straightened out the problem of oxygen metabolism. I have not cured any cancer.

THE DEFENSE MECHANISMS OF THE UPPER RESPIRATORY TRACT. DR. RALPH A. FENTON and DR. OLOF LARSELL, Portland, Ore.

The results of six years of experimental and clinical investigation of the membranes of the accessory sinuses of animals and of human beings are summarized. The first line of defense is the epithelium; the second, the tunica propria with its content of phagocytic neutrophils and histiocytes. Cervical lymphatic glands form the third line of defense, and the fourth is formed by the pulmonary capillary bed, the bronchial lymph follicles and the bronchial and tracheobronchial lymph nodes. The relations of the membranes of the eustachian tube, nasopharynx, larynx, trachea and bronchi to this system of defense are analyzed. The results of various therapeutic procedures on sinus membranes are evaluated.

DISCUSSION

DR. ARTHUR W. PROETZ, St. Louis: I have made a moving picture of some cultures of ciliated nasal epithelium. I managed to grow them for several weeks, not only in strings but finally in spread-out sheets, showing the advancement of cell after cell and also the growth of fibroblasts from the submucous membrane. I have managed to capture some of the phagocytes Dr. Fenton described in action, and they have been photographed at long intervals, so that their activity has been augmented from 320 to 960 times. These pictures will give some notion about how these cells behave.

At the end of the film several fibroblasts are shown splitting. One can see them lengthen, send out pseudopodia and bring them back again, going into great tumult; finally they split and each cell goes its way.

ROENTGEN VISUALIZATION OF THE NASOLACRIMAL DUCT. DR. GEORGE E. HOURN, St. Louis.

In the roentgen study of the lacrimal sac and the nasolacrimal duct, I use a dental film within the nose. The study is facilitated by the use of radiopaque material. A brief discussion of the anatomy and pathology of this area is considered and the adaptation of the method is illustrated by a few selected cases. An intranasal roentgenogram may be of advantage in the study of the ethmoid cells.

The film was shown.

DISCUSSION

DR. JOSEPH C. BECK, Chicago: The detail of trying to fathom the opening of the lacrimal duct from the inferior meatus was nicely shown, and Dr. Hourn modestly said that it had not been tried. It certainly is a rational procedure.

By the use of modern technic, one can produce good roentgenograms of the lateral walls of the sinuses and other structures within the nose.

OBSERVATIONS ON ABNORMALITIES OF THE SINUSES IN CONGENITAL TOTAL AND HEMIABSENCE OF THE NOSE. DR. VILRAY P. BLAIR, St. Louis.

In the study of a small series of cases of hemiabsence of the nose the condition of the nasal passage and of the sinus of that side was found to vary from no symptoms or evidence of lack of proper nasal fenestration, even in the absence of an anterior naris, to the presence of external fistulas or empyema. In 1 instance I was able to remove apparently all the mucous membrane representing the paranasal sinus on that side; in another I made a permanent drainage into the opposite nasal passage; I found evidence suggesting that the missing half of the nose might at one time have been a skin-covered tube lined with mucous membrane and attached above the internal canthus on that side, and in 1 there was apparently a discharge of tears through this tube.

RÔLE OF HELIUM IN CASES OF OBSTRUCTIVE LESIONS IN THE TRACHEA AND LARYNX. DR. JOHN D. KERNAN and DR. ALVAN L. BARACH, New York.

This paper is published in full in this issue of the ARCHIVES (**26**:419 [Oct.] 1937.)

DISCUSSION

DR. THOMAS E. CARMODY, Denver: Could one use an ordinary gas mask?

DR. JOHN D. KERNAN, New York: Yes.

DR. GORDON B. NEW, Rochester, Minn.: I should like to ask about the relative value of oxygen alone as compared with helium and oxygen?

DR. JOHN D. KERNAN, New York: The oxygen will not relieve the sensation of dyspnea, although it is of benefit, as I mentioned in my paper, because there is an increased supply of oxygen to the cardiac muscle and in the circulation. A

smaller volume of gas needs to be moved; so oxygen is of benefit, although the subjective sensation of dyspnea is not relieved, as a rule, because of the weight of the oxygen.

Dr. Burt R. Shurly, Detroit: How expensive is this apparatus, and how immediate is the relief?

Dr. John D. Kernan, New York: I do not know the exact expense. It is expensive, and one cannot obtain oxygen and helium, because the government has stopped the supply. There is a bill before Congress to allow an appropriation for supplying any one who needs it for clinical purposes; so if one is interested one may write to one's senators or congressman.

Dr. Burt R. Shurly, Detroit: How quickly do the patients get relief?

Dr. John D. Kernan, New York: Almost immediately. It is surprising; when they are put in the oxygen, they do not get full relief until all air is expelled, but once that takes place, the relief is immediate. The custom is to run in pure oxygen first to get rid of all air and nitrogen; then the mixture of helium and oxygen is put in. As soon as it is raised to the proper percentage, the relief is immediate.

Dr. Harold Leslie Kearney, New Orleans: I should like to ask whether helium is available for emergencies, and if extraordinary precautions would not have to be taken against explosion.

Dr. Gabriel Tucker, Philadelphia: I should like to ask about cases in which helium and oxygen will not relieve the dyspnea and it becomes necessary to do a tracheotomy.

Dr. John D. Kernan, New York: In the experience I have had with tracheotomy in strangling children, it has always been a rather desperate affair. The child is restless, cyanotic and tossing about; one cannot give an anesthetic to quiet him, and unless the tracheotomy is done by an experienced person, it is likely to result in mutilation of the tissues.

We give the helium and oxygen, and that at least relieves the child to a certain extent. If the condition promises to progress to such a degree that the mixture will not relieve it, preparations are made for bronchoscopy. We then put in a bronchoscope and do a tracheotomy on the bronchoscope.

Dr. Burt R. Shurly, Detroit: How about intubation in some of the cases you mentioned?

Dr. John D. Kernan, New York: If there is no edema of the larynx above the glottis or tumor of the trachea below, intubation may be done.

Dr. William B. Chamberlin, Cleveland: The use of the Mosher tube is much quicker than setting up this apparatus, and after the Mosher tube is introduced dyspnea is immediately relieved, as well as the restlessness, so that even an inexperienced operator can perform a tracheotomy. The intubation tube is much more difficult to introduce than the Mosher tube, and after its introduction it does not have such a large lumen. Furthermore, if there is edema of the upper part of the glottis, one can see how the edema would fold over the end of the intubation tube and so obstruct the breathing. This is obviated by the Mosher tube.

Dr. John D. Kernan, New York: We overcome the time element in two ways. The apparatus is always set up, like a fire apparatus, and a technician is always on duty. If any patient comes into the hospital requiring this treatment, the department of gas therapy is immediately notified and the gas is brought over. As far as the Mosher tube is concerned, I have had much less experience with it than with tracheotomy or a bronchoscopic tube, and I prefer, when necessary, to expose the larynx with a laryngoscope and put in a bronchoscope rather than to use a Mosher tube.

Dr. Thomas C. Galloway, Evanston, Ill.: This apparatus has been used at the Cook County Hospital in Chicago, and it is certainly valuable. I think one point should be emphasized, which perhaps some persons did not understand.

Helium must be given in an absolutely closed system. I have seen an attempt to give it with a nasal catheter. Helium is so light that it immediately goes into the surrounding atmosphere.

Dr. Shurly asked about the cost of the apparatus. The one at the Cook County Hospital cost $800. Naturally, it will not be available except to fairly large institutions.

DR. JOHN D. KERNAN, New York: May I add another thought about helium? The voice, after the use of helium, has a peculiar high pitch until the helium is evacuated from the lung.

DR. V. P. BLAIR, St. Louis: I want to ask whether or not helium and oxygen have ever been used as an adjuvant in caring for edema of the lung. Would that be helpful?

DR. JOHN D. KERNAN, New York: The edema of the lung has been controlled by pressure; that is true. If oxygen, air or a mixture of helium and oxygen is given under pressure, edema of the lung can be controlled. I think it was suggested in 1900 by Haven Emerson.

Book Reviews

The Larynx and Its Diseases. By Chevalier Jackson, M.D., Sc.D., LL.D., F.A.C.S., Professor of Bronchoscopy and Esophagoscopy, Temple University, Philadelphia, and Chevalier L. Jackson, A.B., M.D., M.Sc. (Med.), F.A.C.S., Professor of Clinical Bronchoscopy and Esophagoscopy, Temple University, Philadelphia. Price, $8. Pp. 555, with 221 illustrations, including 11 plates in color. Philadelphia: W. B. Saunders Company, 1937.

The fame, accomplishments and qualifications of the authors of this book are so well known and recognized by laryngologists the world over that nothing further need be said concerning their authority in presenting this textbook devoted exclusively to the larynx and its diseases. They have endeavored to supply a text which will be useful to every practitioner and student of medicine as well as to the specialist, and they have happily succeeded in their purpose. This book is not a compilation of other works but is the result of a vast amount of experience and observation of clinical work in their busy endoscopic clinic. Many interesting deductions are presented.

There are altogether 515 pages devoted to the larynx and its diseases. Eighty-six references are cited, largely from the authors' own papers and compilations, though references are freely drawn from other distinguished laryngologists. Often it was found necessary to compare their own points of view with other prevailing ones, and this they have done well by appending at the end of certain articles the caption "Historical Notes," thus enhancing the teaching value of the subject under consideration. This indirectly aims to establish a basis for the truth in certain controversial problems.

The index is complete and offers the busy clinician a means of finding rapidly the subject matter that he may wish to study and review. It is needless to state that the numerous original sketches, schemata and colored drawings aid tremendously in presenting the teaching vividly and forcefully. Living pathology is literally demonstrated by these means from the wealth of accumulated clinical data available. The colored drawings, made by the authors themselves, are magnificently lifelike.

Though the material in this textbook is full and complete in every detail pertaining to the larynx, there are certain fundamentals that are of particular interest. The authors have always sought to stress the importance of function. Throughout their work their aim has been to preserve the integrity of the function of the larynx and the tracheobronchial tree. Nine functions are assigned to the larynx. A tenth function of the larynx, that of olfaction, has been eliminated in man. The section in which the vast importance of the fixative function of the larynx is so clearly and lucidly set forth is a gem. The description of the protective and tussive function will likewise gladden the heart of the sincere clinician. In discussing these points several otolaryngologists have exclaimed almost in unison: "We never thought of it in that way."

All the dysfunctions of the larynx are thoroughly considered from every angle, whether they are functional, organic or due to faults of innervation, infection of any type, injury or new growth. The treatment of all of these conditions has been thoroughly detailed. Syphilis, tuberculosis and neoplasms of the larynx are covered in such a manner that both the general practitioner and the specialist will be even more on the alert to diagnose these conditions earlier, thus rendering the greatest possible aid to the suffering patient. The subject of hoarseness is painstakingly discussed, so that no one should overlook the likelihood of some sinister condition that would cause irreparable damage, often with resulting death. The endolaryngeal procedures and operative measures are clearly set forth with schemata and drawings.

Finally, any review of the Jacksons' contributions would be incomplete if reference were not made to one of the strongest points that their work possesses,

namely, the explanation of the intricate function of the airway along simple mechanistic principles. Thus the important subject of asphyxia, a condition that every clinician in the field of medicine and surgery and the medical specialties is confronted with at one time or another, is dealt with most dramatically. The check valve action of the tongue is vividly and lucidly described and depicted. The authors have shown painstakingly how the lingual check valve may act in causing death through asphyxia, and methods for dealing with this condition are described in great and clear detail. The check valve explanation is likewise given for cases of bilateral abduction paralysis. A schema is shown illustrating the "cellar door mechanism" of the closure of the glottic chink. The cough reflex, "the watch dog of the lungs," is given due emphasis, and a plea is made that this reflex should never be depressed under any condition (p. 120).

In conclusion, it has not been the aim of the authors to supplant the larger standard works; indeed, they urge the clinician to consult the standard works on anatomy and laryngology freely. They have merely given a complete textbook which embodies a record of their fine clinical work and have added thereto their unique cardinal principles along mechanistic lines, adding immeasurably to the teaching value of the text as well as aiding the clinician to utilize permanent definitive principles for keeping the function of the larynx and the airway "ad integrum."

Directory of Otolaryngologic Societies *

FOREIGN

Collegium Oto-Rhino-Laryngologicum Amicitiæ Sacrum

President: Prof. Gunner Holmgren, Karolinska Mediko-Kirurgiska Institutet, Stockholm, Sweden.
Secretary: Prof. Dr. C. E. Benjamins, Verlengde Heereweg, 143 Groningen, Netherlands.

NATIONAL

American Medical Association, Scientific Assembly, Section on Laryngology, Otology and Rhinology

Chairman: Dr. Gordon B. New, Mayo Clinic, Rochester, Minn.
Secretary: Dr. Leroy A. Schall, 270 Commonwealth Ave., Boston.
Place: San Francisco. Time: June 13-17, 1938.

American Academy of Ophthalmology and Otolaryngology

President: Dr. Frank E. Burch, 408 Peter St., St. Paul.
Executive Secretary: Dr. William P. Wherry, 1500 Medical Arts Bldg., Omaha.
Place: Palmer House, Chicago. Time: Oct. 10-15, 1937.

American Bronchoscopic Society

President: Dr. Gordon Berry, 36 Pleasant St., Worcester, Mass.
Secretary: Dr. Lyman Richards, 319 Longwood Ave., Boston.
Place: Atlantic City, N. J.

American Laryngological Association

President: Dr. J. F. Barnhill, Miami Beach, Fla.
Secretary: Dr. James A. Babbitt, 1912 Spruce St., Philadelphia.
Place: Atlantic City, N. J.

American Laryngological, Rhinological and Otological Society, Inc.

President: Dr. Samuel J. Kopetzky, 71 E. 80th St., New York.
Secretary: Dr. C. Stewart Nash, 708 Medical Arts Bldg., Rochester, N. Y.
Place: Atlantic City, N. J.

SECTIONS:

Eastern.—Chairman: Dr. Louis H. Clerf, 1530 Locust St., Philadelphia.
Southern.—Chairman: Dr. Murdock S. Equen, Medical Arts Bldg., Atlanta, Ga.
Middle.—Chairman: Dr. James B. Costen, Beaumont Bldg., St. Louis.
Western.—Chairman: Dr. Arthur C. Jones, 105 N. 8th St., Boise, Idaho.

American Otological Society

President: Dr. Harris P. Mosher, 828 Beacon St., Boston.
Secretary: Dr. Thomas J. Harris, 104 E. 40th St., New York.

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* Secretaries of societies are requested to furnish the information necessary to keep this list up to date.